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Smart solar futures: politics and instability in off-grid electrification in Odisha, India

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Abstract

This thesis explores the politics and social structures surrounding community-scale, off-grid, solar PV micro-grids in eastern India. It offers a novel, synthetical perspective drawing on a situated, grounded and in-depth analysis of one of India's first 'smart' solar micro-grids, installed in Urjapur, a village in a tiger reserve in central Odisha. It takes an interdisciplinary approach, drawing from development studies, anthropology, science and technology studies, South Asian studies and social geography to explore the nuances surrounding technological developments at the intersection of rural development, energy access, sustainability and 'smart' village movements.

The research used ethnographic methodologies, including informal interviews, discussion groups and participant observation. The fieldwork for this project was multi-sited, and primarily took place in Odisha over a year-long period. The main field site was Urjapur, the village where the micro-grid was installed, with supplementary periods based with the engineers implementing the system and in Delhi, based within policy and research organisations working on energy access.

The thesis conceptualises the micro-grid as an assemblage of technologies, infrastructures, ideologies, institutions and relationships. Drawing on ideas from the literature around the social construction of technology, I argue that this assemblage was constantly evolving and being reshaped, having been 'scripted' by its designers, and then 're-scripted' by users, as well as numerous state and non-state actors. This framing enables interrogation of the interplay between the individuals, groups and community envisaged as users of the micro-grid system and the engineers designing it. The thesis deconstructs the dissonant meanings derived from the 'smart' micro-grid system by the range of actors surrounding it and explores the contrasting visions in the types of development proposed. I argue that the needs, aspirations and values of the village community were often different from those of the implementers. Conceptualisations of the South Asian term *jugaad* (innovative processes of frugal problem solving and ways of enacting agency) are used to understand the implications of these dissonances, and the resulting processes of appropriation, negotiation and subversion in response to the micro-grid, within a legacy of existing development projects in the community.

This analysis is embedded within the local Odisha context, which is essential in understanding the micro-grid project and provides a key contribution of the thesis as a whole. Analyses of the social, political and environmental landscapes intersecting with the project are a central component of the ethnographic approaches used. Structures pertaining to gender, caste, tribe and class hierarchies are explored throughout the thesis as they are embodied within the relationships surrounding the micro-grid and the materiality of the system itself. In particular, the usage of feminist perspectives highlights the role of gender structures across the micro-grid and off-grid energy assemblage in reasserting specific relationships and hierarchies. This is explored within the Urjapur community, but also in external sites of technology design and control, and of policy and project development.

The local politics around state inclusion and forest conservation are central to the contextual components of this thesis. The politics associated with forest management are examined to understand their impact on community life and their role in shaping the micro-grid. Through this, the thesis explores contradictory understandings of 'sustainability' that derive from the politics of the technology and of the forest. It also explores the wider ecosystem of micro-grids across the state to understand the intersections between the different groups installing micro-grids, including NGOs, government agencies and businesses. I argue that, across the state, these projects often failed to realise their aims and goals, in part through conflicted expectations of what rural communities should look like, a misunderstood reality of how those communities functioned and a failure to examine their own expectations and aspirations for energy usage. Despite the frequent failure of micro-grid projects and the intense processes of renegotiation around the Urjapur, this thesis also utilises concepts of charisma to explore the 'hype' around 'smart' micro-grids, and argues that this was more central to mobilising the micro-grid assemblage than the realisation of the project within the community.

Lay Summary

This thesis explores politics and social dynamics surrounding community-scale solar energy micro-grids installed in rural eastern India. It is based on a year-long period of ethnographic fieldwork in the state of Odisha, consisting of unstructured interviews, participant observation and discussion groups. Its primary case study is Urjapur, a village in central Odisha, where one of India's first 'smart' solar micro-grids was installed inside a tiger reserve. The project had been envisaged with ambitious, hi-tech visions for the future of rural villages and aimed to provide clean, sustainable energy supplies for communities off the grid. However, this thesis examines the localised responses to the project, and particularly the ways in which local communities drew different and often conflicting meaning, opportunities and values from the systems. This thesis explores how the structures of gender, caste, tribe and class intersected with the relationships and ideologies of the micro-grid, arguing that gender in particular played a key role in how the system was design and used.

Central to the thesis is establishing an understanding of the micro-grid within its local context. It looks at the ways in which the aims and visions of the micro-grid intersected with the politics of conservation in the forest surrounding it. It also looks at the wider development of micro-grids across the state to understand how the social structures and expectations embodied the politics of the different groups implementing them. However, it argues that through competition with the main grid, abandonment by implementors and the disillusionment of local communities, many of these projects ultimately failed to achieve their aims. With respect to this, this thesis then explores how the visions for 'smart' micro-grids mobilised the continued investment in them, even when this conflicted with the ground-level realities of them.

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Useful Translations and Meanings

(As detailed in chapter 2, for the most part, quotes throughout this thesis have been translated directly into British English. Provided here is a glossary of key Indian English, Hindi and Odia terms used in the thesis, but which lack direct translations or require more detail to elicit their full meaning in context.)

Adarsh Gram	Ideal/model/smart village
Adivasi	Indigenous tribes of India, defined by Indian government as 'scheduled tribe' (ST)
Beedi	Thin, hand-rolled cigarettes
Bijili	Electricity
Chakli	Deep fried snack
Charka	Domestic spinning wheel
Dalit	Those excluded from the Indian caste system, meaning 'oppressed', defined by Indian government as 'scheduled caste' (SC)
Dhaba	Roadside food stall/restaurant
Dibri	Small, wick lamps used to burn kerosene
Firangi	Foreigner (especially white and British)
Gaon	Village
Godown	Warehouse or storeroom
Gowda	Caste group in Odisha traditionally involved in animal herding
Gram Panchayat	Elected village council
Jamun	Type of fruit
Jogad/Jugaad	To make do, innovate, find a work-around
Kendu	Leaves made to use beedis
Khajuri Tadi	Local alcohol made from *mahula* date trees

Kirana	Small, family-owned shop
Kutcha	Makeshift, temporary, often referring to structures and infrastructure made from earth
Lakh	One hundred thousand
Lehenga	Type of skirt worn at formal occasions
Mahula	Type of date tree
Naxalites/Naxals	Members of militant Maoist insurgency groups operating in eastern India
Paan	Chewing tobacco
Paddy	Rice crops
Pucca	Solid, strong, permanent (opposite to *kutcha*)
Sahi	Hamlet
Saubhagya	Central Indian government scheme for rural grid extension
Swadeshi	Gandhian notion around 'own country', self-sufficiency
Swaraj	Self-governance or self-rule
Ujjwala	Central Indian government scheme providing LPG

Abbreviations

ASHA	Accredited Social Health Activist
BDO	Block Development Office
BJD	Biju Janata Dal (political party currently in power in Odisha)
BJP	Bharatiya Janata Party
BPL	Below poverty line
CSR	Corporate social responsibility
DC/AC	Direct current/alternating current
DFO	Divisional Forest Officer
DG	Diesel generator
FTS	Feminist technology studies
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
IAY	Indira Awaas Yojana (Government housing scheme, now renamed Pradhan Mantri Awaas Yojana Gramin (PMAYG))
IIT	Indian Institute of Technology
INGO	International non-governmental organisation
JICA	Japan International Cooperation Agency
KBK	Kalahandi-Balangir-Koraput region of western and southern Odisha
LABL	Light a Billion Lives project
LED	Light emitting diode
LPG	Liquefied petroleum gas
MGP	Mera Gao Power
MLA	Member of Legislative Assembly

MNRE	Ministry of New and Renewable Energy
NGO	Non-governmental organisation
NRHM	National Rural Heath Mission
OBC	Other Backward Caste
OFDC	Odisha Forest Development Corporation
OREDA	Odisha Renewable Energy Development Agency
PM	Prime Minister
PV	Photovoltaic
SC	Scheduled Caste
SCOT	Social construction of technology
SDG	Sustainable Development Goals
SHG	Self-help group
ST	Scheduled Tribe
STEM	Science, technology, engineering and mathematics
STS	Science and technology studies
TERI	The Energy and Resources Institute
UNDP	United Nations Development Programme
WASH	Water, sanitation and hygiene

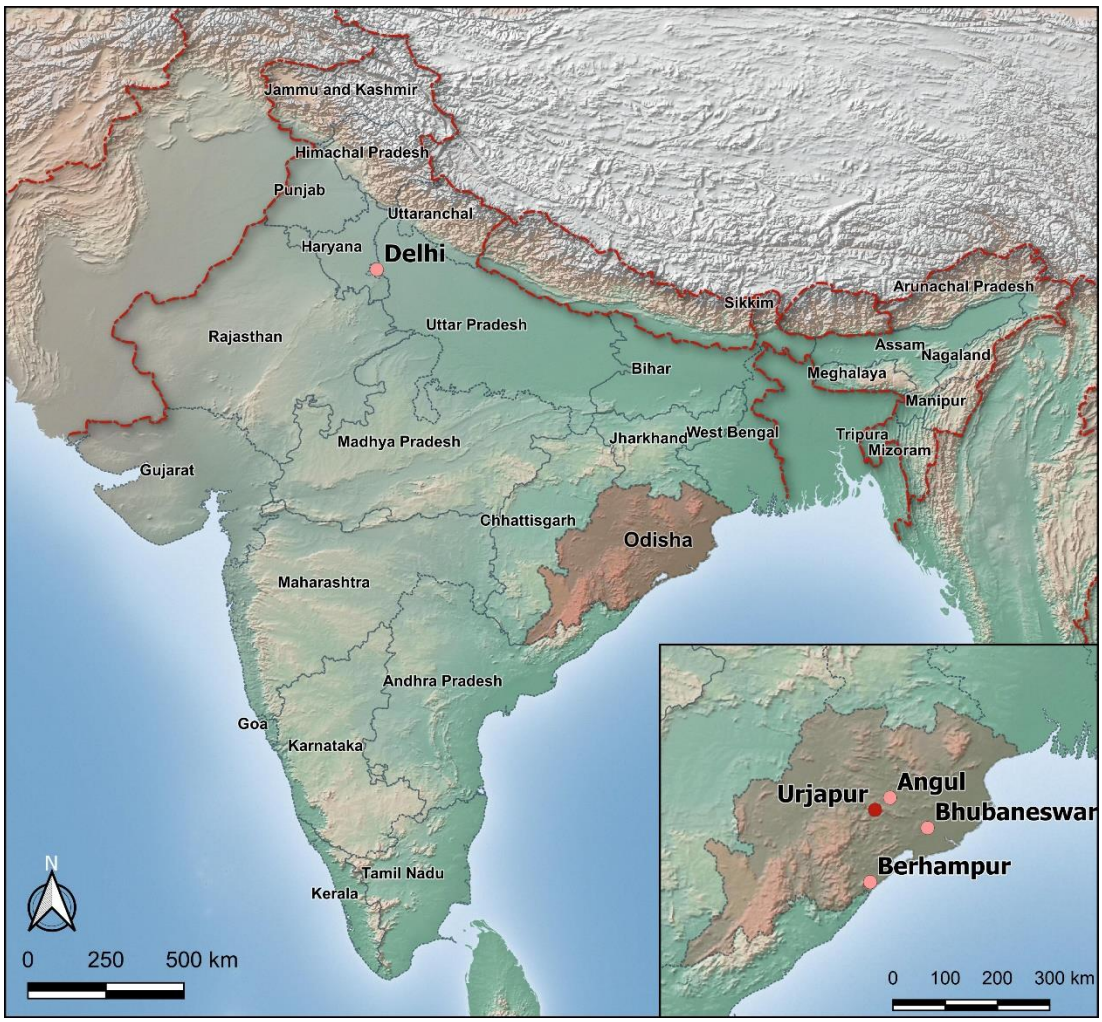

Figure 1: Location of fieldsite.

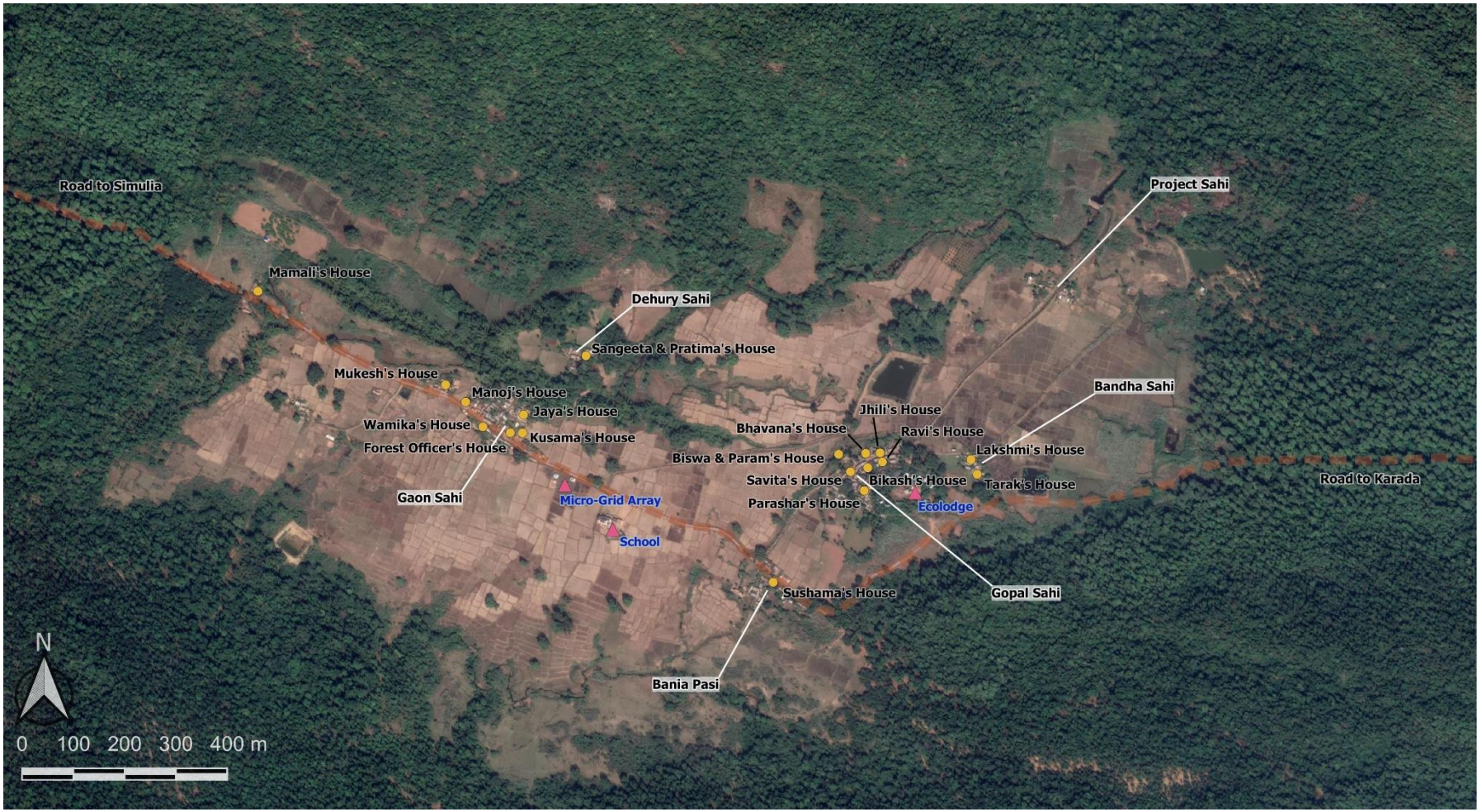

Figure 2: Map of Urjapur village.

1. Introduction

Fieldnote excerpt: June 2017

Mukesh carefully unlocked the control box for us to see inside. As he opened it, we were hit by the smell of fried wires and melted plastic (see figure 3). The inside of the box was blackened with charring from the fire and most of the smart meters had melted into congealed lumps of plastic. It was far from the sleek, polished images of Urjapur's clean, green, smart micro-grid proliferated by SolarFuture.

Figure 3: Burnt control box.

Subhra, my research assistant, asked what had happened and Mukesh shrugged.

"Maybe a lizard or animal got inside and shorted the circuit. When the fire started, they [the women in the hamlet] were scared it would spread to the houses, so they threw water on it to try to put it out."

He gestured to the flammable wooden fencing that ran alongside the control box, next to the thatched roofs of the nearby houses. The now incinerated control box had housed meters for all the houses in the hamlet, regulating when they could access electricity and monitoring their consumption.

"I came as fast as I could to warn them not to put water on the fire and I managed to disconnect the box. There's a fire extinguisher in the control room, but it's the other side of the village. By the time we put the fire out the whole box was destroyed."

The damage was extensive and there was no way to tell exactly what had happened. It might, as Mukesh said, have been an animal in the box. Or there might have been a fault in the

design which had caused the fire. It crossed my mind that the fire could even have been started deliberately, given the increasingly frequent complaints I had been hearing about the micro-grid.

It had been a strange morning. I had been travelling from the Odisha state capital, Bhubaneswar, to Urjapur and, on the journey, had received an urgent phone call from Anshuman, the head of SolarFuture, about a fault in the micro-grid.

“Just go and have a look at it and WhatsApp me some photos of the control box,” he had said.

I agreed, curious to see what had happened, and aware that it might be days or weeks until one of his engineers would visit the village.

That evening, I sent photos of the box to Anshuman and phoned him to relay Mukesh’s theory on what had happened, emphasising the extent of the damage and the potential danger the fire had posed.

He sighed, “We’ll have to go back to the donor to get the money to get it repaired. People haven’t been paying enough, so the system isn’t insured. It’s going to cost a lot to replace those meters, they’re the most expensive part of the system. If it keeps breaking down, we won’t always be able to fix it, eventually they’ll need to understand why they have to pay for the electricity from the system.”

Twenty households were left without electricity due to the fire, but it was a blessing that no one was hurt and it had not spread further. A few days later, there was also an upside. Mukesh managed to supply the hamlet with a direct connection to the micro-grid by bypassing the control box, and the smart meters within it. The monitoring and regulation that went along with them was also bypassed. Before long, TV soaps and music were playing all day long, instead of during the strictly scheduled hours mandated through the smart system, as the people living in the hamlet took full advantage of the mishap.

1.1 'Smart' Village

In July 2016, an article was published by BBC news about "India's Smart Villages".[1] The article centred on a social entrepreneur working to develop 'smart' solar photovoltaic (PV) micro-grids who was using hi-tech, data driven, remote monitoring technologies alongside solar PV infrastructure to provide electricity for remote communities. In a quote, the entrepreneur described his approach, saying, "City-dwellers tend to take electricity for granted, but for the roughly 200 million Indians living off-grid, access to power is a privilege, not a right. These are fertile grounds for experimenting with smarter ways of using energy, that could help the rural poor leapfrog traditional power networks to a greener, community led approach." The article described his project in Urjapur, a small village in central Odisha (formerly Orissa), where he had installed what was said to be India's first 'smart' solar micro-grid system, funded by an international power company through a CSR programme. The article described the micro-grid, saying:

> *Power is provided by a 30kW solar plant and meters and sensors collect data on energy usage and system health. This information is fed into SolarFuture's cloud-based monitoring system, which can be accessed by the company's staff anywhere. This makes it possible to remotely manage supply and demand and schedule power-hungry activities like irrigation pumping for agriculture and new microenterprises that have sprung up, like a food packaging business and a store that sells cold drinks. Wi-Fi hotspots let villagers access local intranet via a language-independent mobile app to view their consumption, pay bills and register complaints. If users exceed their allowance, they can be shut off to avoid overloading the grid and faults can be spotted remotely before villagers trained in basic repairs are sent to fix them.*

It quoted the deputy director of the state renewable energy office, who provided support to the project, comparing the system to other off-grid solar projects. "You get a lot more control," he said. "It brings a real solution to a village; otherwise we install a system and don't know what happens to it when we leave." The article outlined the accolades the project had already received; winning the "Smart Village" category of the Smart Cities India Awards and

[1] Due to commitments to anonymity and confidentiality in this thesis, this article and others directly relating to the field site will not be cited. The names of individuals, villages and organisations who I worked with directly as part of my fieldwork have been replaced with pseudonyms to protect my interlocuters. Government bodies, names of institutions and public facing individuals referenced in this thesis have not been anonymised. More detail on the ethical components of the data collection can be found in chapter 2.

commendation by government ministries, who agreed to support subsequent projects for an entire smart village cluster. The article cited the railway board wanting to use the technology to enable train stations to act as local power hubs and mining firms scouting the technology to provide power for settlements relocated due to mining activities, as evidence of its widespread appeal.

In the article, the entrepreneur spoke to the potential of the smart systems, saying, “it could also make villages truly smart by monitoring things like water consumption or environmental factors for agriculture. The communications network the system puts in place provides a backbone for future e-governance, telemedicine and tele-education applications”. In the final line of the article, the social entrepreneur was quoted as saying “The smart grid acts as a catalyst in the village and then all the other things become possible. The potential is huge.”

This article was published while I was in India on a scoping trip for my upcoming PhD fieldwork, where I was planning to study the social structures and politics around solar micro-grids in Odisha. Alongside its serendipitous timing for my project, the article captured the essence of many of the wider narratives around off-grid renewable energy projects. The article painted a powerful picture of what off-grid energy could do, particularly in its iteration of community scale, hi-tech, data-controlled solar micro-grids. The vision captured in the article was compelling. It told of a future clean and technology driven utopia in even the most remote of places, where even the poorest of community members might interact with their green energy connection through mobile apps and where energy could catalyse enterprises and data driven agricultural practices. The idea of a rural Indian village (arguably often romanticised in mainstream perceptions, in India and globally, by their ‘quaint’, ‘low-tech’ and agrarian lifestyles (Gupta, 2005)) with e-governance, telemedicine and tele-education (whatever those might mean in reality) seemed almost fantastical. The alignment of the ‘smart’ village concept with the ‘smart cities’ movement engaged with a wider rhetoric around innovation, entrepreneurship and technological networking (Kitchin, 2015). Alongside this, however, there were conspicuous absences from the article. It included pictures of people in the village, but with no quotes, opinions or even mention of their engagement with the micro-grid. It was clear the journalist had not visited the village, but also reflected many of the wider discussions around off-grid energy, where those using the energy often seem to have the smallest representation in debates about it.

I flew to Bangalore later that week and met the social entrepreneur, Anshuman, to learn more about the project. Eventually, months later, when I returned to Odisha for a year-long period of ethnographic fieldwork, Urjapur, the village featured in the article, became my main field site and case study for my PhD. The reality of the community's engagement with the micro-grid, as well as the ever-evolving politics surrounding it, were, unsurprisingly, infinitely more complex than in this initial portrayal.

This thesis explores the socio-political processes around the Urjapur micro-grid. It conceptualises the micro-grid as an assemblage of ideologies, technologies, relationships and social structures that sit within wider development discussions (Ong & Collier, 2005; Marcus & Saka, 2006; Murray Li, 2007). I argue that in the local context, this assemblage was constantly being pulled apart, disassembled and remoulded (Grove & Pugh, 2015) by the community using it, and was subject to a constant process of negotiation between the engineers of the system, groups within the village community and by local state actors. This thesis explores these processes of deconstruction, resistance, subversion and appropriation in how people engaged with the micro-grid. It interrogates the ideologies that it represents and how actors within it sought to redefine, remould and re-script (Akrich, 1992) the technological innovation within the context of rural Odisha. These 'actors' refer not only to the community using the system, but also to the ongoing engagements of the engineers in re-interpreting the system, to state actors who were participating in the remoulding of the system and even to elites in Delhi policy making circles, reinterpreting local practices and narratives to support policy agendas (Mosse, 2004). However, I also argue that despite these attempts to deconstruct and undermine the system, the 'smart' micro-grid assemblage remained adhered through the charisma (Mazzarella, 2010; Ames, 2015) attached to the people and ideas it promised to an outward facing audience to legitimise its project (Gardner, et al., 2014), evidenced in the form of the aforementioned BBC news article among others. Critical throughout this are the gender power structures that were inherent across the micro-grid assemblage, from the village it was installed in, to the university it was designed in and the policy and research spaces in Delhi which influenced the conversations in the off-grid energy sector as a whole. This thesis argues that these gendered components were central to both the assembling and deconstruction of the micro-grid assemblage.

Central to this thesis are aims to deconstruct the meanings, politics, ideologies and processes embodied within the micro-grid system. I aim to prioritise the perspectives of those most

marginalized within the processes of rural electrification, and to interrogate inequalities within the power structures which intersect with these processes. Through these perspectives, I aim to decentre my analysis of 'smart', off-grid networks from often dominant narratives based within the energy sector and within global discourses. Critical to this of the use of feminist approaches, with emphasis on the active role played by user communities in shaping of technologies, processes and outcomes (MacKenzie & Wajcman, 1999), as a counterpoint to the roles played by state actors, engineers, implementers and policy makers. This enables me to deconstruct and challenge some of the normative assumptions made within academic and practical analyses of micro-grid systems and to engage with the roles played by the wider contextual framings of such projects.

This introductory chapter aims to lay the groundwork for much of the theoretical and contextual framing of the thesis. I first explore the wider development context, framing the development narratives within which the micro-grid fits, including debates and discussions on energy access, sustainability, rural electrification and development, and smartness. In this introduction, I provide only a brief overview of the debates and discussions taking place globally around these topics. These could be extended much further, but are outlined here with the aim of detailing the development logics which have been used to justify the implementation of micro-grids across India, as well as some of the contentions which exist around their implementation and shortfalls.

Next, it outlines some of the gaps and limitations in the study of micro-grids thus far, arguing that there is a need for greater understanding of the power dynamics and politics around micro-grids. I then explore potential ways to understand the social politics around micro-grids and outline the context-specific politics and social structures which are fundamental to understanding any development project or technological innovation in Odisha. This thesis takes an interdisciplinary approach to the study of micro-grids in Odisha, drawing influences from a range of disciplines and sub-disciplines within the social sciences, including science and technology studies, development studies, geography, South Asian studies and anthropology. Particularly within the context of international development and engagement with global challenges and transitions, this grounding provides better equipment with which to engage with the complexity of the issues presented in the data (Harriss, 2002). This also builds on the existing rich and diverse multidisciplinary literature engaging with the topics of energy access, rural development and technology development, as well as the context itself.

1.2 Wider Context

The BBC article is only the tip of the iceberg in the global developments, discussions and debates around off-grid solar micro-grids. The idea of the 'micro-grid' (sometimes referred to as mini-, pico- or nano-grids, largely dependent on their size and capacity (Bhattacharyya, 2018)), as an islanded community-scale electricity system, often powered through renewable energy sources (Bhattacharyya & Palit, 2014), has captured the imaginations of researchers, policy makers, technologists and development practitioners around the world (Bhattacharyya & Palit, 2014; International Energy Agency, 2017; Stephens & Vermani, 2018).

The technologies associated with off-grid micro-grids follow a legacy of decentralised energy innovations. Perhaps the most ubiquitous across India is the diesel generator (DG) set, used in both urban and rural settings as a backup to grid blackouts or to provide electricity where none is available. These range in size from small-scale generators powering lights, small machinery or TVs, to large scale sets powering entire apartment blocks, hospitals and communities. DG sets are found across India, used by urban elites and the rural poor. However, it is renewable and low carbon energy innovations which now dominate many of the contemporary discussions around off-grid energy and electricity generation (Hiremath, et al., 2009). This includes biomass, biogas and wind generation, but decentralised solar PV energy has perhaps made the biggest impression in the off-grid energy world, not just within India but also across Sub Saharan Africa, Latin America and other areas of Asia (Akikur, et al., 2013). Off-grid solar PV for micro-grids follows and parallels an evolving legacy of solar power lanterns (Cross, 2018) and solar home light systems (Nieuwenhout, et al., 2001), alongside solar water pumping (Chandel, et al., 2015), street-lighting (Ciriminna, et al., 2017) and numerous other solar powered innovations. While this thesis focuses primarily on the solar micro-grid, the research and discourses around these other solar products and systems also informs the analyses.

It is unclear exactly how many micro-grids there are in India (Prayas Energy Group, 2014), in part due to the absence of regulation in the off-grid energy sector (Palit & Bandyopadhyay, 2015). There is evidence of numerous individual government agencies, businesses and NGOs pledging funding for tens of thousands of micro-grids (Fowlie, et al., 2018; Schnitzler, et al., 2014). This is on top of organisations with existing micro-grid installation across the country (Kumar, 2019a). If the publicised numbers came to fruition it would mean that millions of people would be access power through renewable energy micro-grids. In reality, there is

significantly less evidence for how many have actually been installed and even less for how many are still functional (Palit, et al., 2013; Schnitzler, et al., 2014). However, given the lack of clarity on how many functional micro-grids exist in India, it is arguable that much of the 'buzz' surrounding them revolves as much around the promises of what micro-grids could be and the future imaginaries they propose as the wide scale realisation of their potential.

In India and across the Global South, micro-grid technologies intersect with numerous development movements concerning rural development and electrification, energy access and sustainability, and smart and clean technology. These movements involve discussion and debates held at different levels and by many different actors, with significant overlaps and intersections, but provide numerous framings and developmental logics for the micro-grid.

1.2.1 Energy Access

The development and implementation of micro-grids in India, and across the Global South, stems from the global development dialogues around energy access (Srivastava & Rehman, 2006). On a global scale, off-grid energy[2] has been central to strategies to meet global targets for energy access, featuring in Sustainable Development Goals (IRENA, 2018) and the development policies of numerous governmental and intergovernmental organisations (Palit & Chaurey, 2011). There have been numerous, sometimes overlapping, definitions for what constitutes 'energy access', with shifts away from binary measures towards frameworks for assessing a multiplicity in what constitutes access to 'modern' energy (Pachauri & Brew-Hammond, 2012; Nicolina & Bhatia, 2014).

The term 'energy access' needs to be understood with reference to localised contexts, lifestyles and values, but is generally acknowledged to include household electricity access, sustainable, safe and 'modern' cooking and heating methods, energy to enable productive economic activity and energy for public services such as schools, hospitals and street-lighting (World Energy Outlook, 2015). Access to energy, and specifically to electricity, has long been cited as being a crucial factor in poverty reduction, from both economic and human centric

[2] The term 'off-grid' is used, in this thesis and elsewhere, to refer to an implicitly discrete category of people and places outside the range of electricity grids. This separation between 'on-grid' and 'off-grid' could be helpfully deconstructed (Cross, 2017). Terms including 'under-grid' have been usefully developed to conceptualise nuance within this categorisation (Lee, et al., 2016). This thesis will not attempt to redefine the on-grid/off-grid paradigm to a huge extent, but uses the term off-grid to refer to Urjapur, which, at least during the period of fieldwork (see conclusion), was decidedly off-grid, in the stereotypical sense of being physically beyond the reach of the national electricity grid.

development perspectives (Pachauri & Spreng, 2004; Gaye, 2007; Kanagawa & Nakata, 2007; Bhattacharyya, 2012). Electricity access has been argued as a precursor to increased productivity, as a facilitator of industry and to enable increases in individual income, thus contributing to economic growth (Cabraal, et al., 2005). Equally, electricity is also seen as being crucial to human well-being, with the capacity to reduce illness related to kerosene usage, to increase access to healthcare and education and to allow students the ability to study for longer hours (Barnes, et al., 2014). Within development discourses in particular, the necessity of electricity access, particularly referring to lighting, as a basic human is need rarely challenged (Gupta, 2015).

Official statistics currently estimate that 840 million people globally and 99 million in India are unelectrified (The World Bank, 2019), though within India state provided statistics for electrification have been critiqued, particularly since binary measures of electrification fail to provide nuance on the quality of the grid electricity supplied (Banerjee, et al., 2015). However, rates of electrification have dramatically increased in recent years, with ambitious government-led initiatives to increase electrification, particularly in rural areas, alongside the mobilisation of entire industries looking to facilitate energy access diverging from the traditional state provided grid. These have coincided with global mandates for increased energy access, including Sustainable Development Goal 7 (The World Bank, 2019).

1.2.2 Sustainability

Encapsulated within debates around energy access are anxieties around sustainability and climate change. Energy access movements have become synonymous with drives towards clean and renewable energy sources. In India, drives towards wide scale electrification have been underpinned by ominous questions of how to meet demand sustainably within planetary environmental boundaries, particularly given the coal intensive nature of India's electricity generation (Molyneaux, et al., 2016). In itself, this intersects with many of the global climate justice debates around the rights and responsibilities of climate change, within the paradigm of industrialisation in the Global South. Akhil Gupta highlights a quote from Gandhi to this effect:

> "Gandhi was prescient about the unsustainability of modern developmental models when he reportedly said: 'If it took Britain half the resources of the world to be what it is today, how many worlds would India need?'"
>
> (Tolba, 1987, p. 118) quoted in (Gupta, 2015, p. 566)

Both grid-connected and off-grid renewable options, including solar PV electricity production, alongside wind and biogas, have played into virtuous narratives in sustainability and climate debates. For many, solar energy is the 'silver bullet' technology that can meet energy needs, particularly in developmental contexts, without an irrecoverable strain on the global climate (Kumar, et al., 2010). Decentralised solar PV, in comparison to the grid, can be envisaged as a clean and 'guilt-free' option, sometimes referred to as a 'leapfrogging' technology, which could bypass carbon intensive grid electrification while providing developmental benefits (Szabó, et al., 2013; Zhang, 2014). This concept, however, can be critiqued (Perkins, 2003), and implies the exclusion of certain people from national infrastructures, such as the grid. These also sit alongside narratives which, on occasion, frame the 'rural poor', in and of themselves, as 'dangers' to their environment, for instance through the use of biomass for cooking, which is said to increase deforestation (Mehetre, et al., 2017). This is particularly pertinent in this thesis, in that Urjapur, the site of the micro-grid, was situated inside a tiger conservation area and mired in contentions around the 'threat' of the communities on the forest around them. This is explored in more detail with relation to the micro-grid in chapter 5 of this thesis.

1.2.3 Rural Electrification

In many areas of the Global South, micro-grids have been touted as part of the proposed solution to inadequate, corrupt or sluggish grid extension in rural areas (Palit & Sarangi, 2013). Off-grid solar interventions have been framed as a decentralised, clean and sustainable counterpoint to the monolithic, unclean and inefficient grid (Morris, 1996). They therefore fit into the long and complex histories of rural electrification in India. Since independence, the expansion of electricity grids has been a key marker of the 'state-building' process (Kale, 2014a). Grid extension features heavily in election manifestos on state and national levels, including Prime Minister Modi's 1000 day village electrification promise made in 2015 (Bhaskar, 2018). The milestone of every village in India being electrified was said to have been achieved in April 2018, when the village of Leisang in the north-eastern state of Manipur was connected to the grid. Critics, however, were quick to point out that tens of millions of households were still unelectrified, largely because the Indian government deemed a village "electrified" once power cables reach a transformer in the village and once 10% of its households are connected (Heynen, et al., 2019a). Equally, across Indian urban centres and rural villages, power cuts and blackouts remain common; in rural Odisha over 50% of electrified households are said have less than 12 hours of power supply per day (Jain,

et al., 2015). Electrification statistics are also notoriously inconsistent (Dutt D'Cunha, 2018). Despite the dramatic advances in electrification in rural India, there still remains a huge proportion of the population without electricity. Critically, Dalit (SC), Adivasi (ST) and Muslim households are disproportionately left off-grid in India (Kemmler, 2007; Oda & Tsujita, 2011; Saxena & Bhattacharya, 2018), emphasising the social and political components of electrification, which go far beyond the technical and economic limitations of grid extension.

For many, both in and outside of the Indian state, off-grid energy is seen as playing a critical role in 'filling the gaps' where the grid does not extend. The logic behind these proposals is that decentralised, distributed energy generation can bypass traditional large-scale electricity grid and meet household, community, manufacturing and agricultural energy needs in areas where the grid is said to be economically unviable (Nouni, et al., 2008; Palit & Bandyopadhyay, 2017), environmentally damaging (Heynen, et al., 2019) or of low political priority (Kemmler, 2006; Oda & Tsujita, 2011; Gupta, 2015). Equally, micro-grids have been proposed as an additional power generator in places where the grid exists, but where supply is intermittent or unreliable (Palit & Bandyopadhyay, 2017).

1.2.4 Rural Development

Calls for micro-grids, within the umbrella of off-grid solar technologies, also fit within specific developmental narratives, arguably extending beyond those associated with the main grid. Main grid extension projects rarely inscribe within them what exactly the electricity is intended for, or how it should be used. By contrast, off-grid energy research and development has a tendency to centre around very specific energy uses and ascribe them to specific and prescriptive developmental outcomes (Cloke, et al., 2017). Among the wide reaching claims that exist are that solar lighting increases children's attainment levels (Gustavsson, 2007), that solar street lights protect women from violence (Clancy & Skutsch, 2003), that the enterprises using solar energy would kick start local economies (Meadows, et al., 2003) and that solar could be used to transform rural health provision through the use of solar refrigeration and solar lighting (Harsdorff & Bamanyaki, 2009; Sustainable Energy for All, 2019). The evidence for many of these claims has been critiqued (Aklin, et al., 2017), and often does little to acknowledge the systemic factors mediating the developmental 'success' of solar interventions (Kumar, 2018).

As seen in the BBC article, the narratives around micro-grids also often engage with specific developmental futures. These range from discourses of 'empowerment' where communities

can ‘take control’ of their own energy generation, often in line with both marketised development approaches, to idealised versions of the ‘self-sustainable’ Gandhian village (Jolly, et al., 2012; Anderson, et al., 2017). This is indicative of many of the actors involved with off-grid energy, who have often coalesced to a greater extent around the ‘development’ sector (Bhattacharyya & Palit, 2016), with engagement from non-governmental organisations, on local, national and international scales (Singh, 2016), ‘social enterprises’ (Tonia & Houndonougbo, 2016; Cross, 2019b), specific government bodies (Millinger, et al., 2012) and, to an increasing extent, private businesses (Jolly, et al., 2012; Heynen, et al., 2019b). The diversity of financing mechanisms for off-grid projects and micro-grids also arguably impacts their aims and goals, with increased dependency on national and international donor agencies, corporate social responsibility (CSR) and seed investment funding (Palit, et al., 2014; Singh, 2016). These funding streams are often combined with a variety of strategies for the localised ‘sustainability’ of the systems, such as contributions from users to maintain and upgrade equipment (Jolly, et al., 2012; Ubilla, et al., 2014).

On the ground, however, off-grid solar technology is not without its critics or problems. Later in the BBC article, the social entrepreneur blamed a ‘sell and run’ approach to disseminating solar for its wide-scale association with breakdown and failure (Cross & Murray, 2018). Despite the flexibility and adaptability of the technology for a wide range of uses, it also has limitations in terms of capacity and design, depending heavily on battery technology for periods without sunlight. Many of these limitations are explored within this thesis.

Throughout my fieldwork, in Hindi, English and Odia, solar PV technology, referring to solar powered lanterns, streetlights, home lighting systems, pumps and micro-grids, was referred to in vernacular form as simply “solar”. Referred to in this form, it was explicitly distinct from ‘grid’, ‘current’, ‘*bijili’* or any other term referring to government grid supplied electricity (Sharma, 2020). This was regardless of whether the solar PV, for instance in the case of the micro-grid, was used for the same purpose as the grid, such as lighting, phone charging, TVs or water pumping. This thesis utilises the vernacular usage of ‘solar’ in the discussion at points, which should be distinguished from other more generic potential uses of solar energy, for instance in solar thermal configurations.

1.2.5 Smartness

One of the central defining features of the Urjapur micro-grid was the ‘smart’ technology incorporated to enable real time monitoring and control of the system, through a satellite

connection to the control room 300 km away. The 'smart' component of the Urjapur micro-grid was a key feature in the construction of the charisma around it, particularly to external audiences. This component cast the village in its entirety as a 'smart' village (Zavratnik, et al., 2018). The concept of the 'smart' village aligns with the 'smart' cities movement, defined by the integration of digital ITC technologies with traditional infrastructures, utilising data-led networking to create an 'Internet of Things' (Batty, et al., 2012; Rao, et al., 2018; Chin, et al., 2019).

Definitions of 'smart', in terms of both technologies and wider villages and cities, are somewhat nebulous, with the term becoming something of a buzzword, as much as a concrete concept or set of approaches (Angelidou, 2014). The definitions of 'smart cities' generally include reference to the use of information and communication technologies integrated within urban infrastructures and engage with the ideas of sustainability, liveability, efficiency and equitability (Alawadhi, et al., 2012). The discourses around 'smart villages' engage with similar themes, often alongside connectivity, resilience and self-sufficiency (Holmes, 2017). Additionally, the development of 'smart villages' in India specifically has also engaged with Gandhian concepts of *Adarsh Gram* (ideal village) and *Swaraj* (self-rule) (Ramesh, 2018). The concepts around this were mobilised to establish PM Modi's 2014 scheme, *Sansaad Adarsh Gram Yojana* (Model Village) which aimed for the 'holistic' development of entire villages, in large part achieved through the use of technological innovations (Government of India, 2014).

The term 'smart' originated with the acronym 'Self-Monitoring, Analysis and Reporting Technology', but has since evolved to refer to the automated, networked and 'intelligent'/learning capacities of certain technologies and systems (Worden, et al., 2003). The incorporation of 'smart' technologies within the energy sector on a global level has largely been associated with the use of 'smart' metering, particularly aiming to streamline and increase efficiency in their energy systems (Reddy, et al., 2014). The future imaginaries associated with 'smart' technology and 'smart grids' are also highly contextual (Skjølsvold, et al., 2015). Where, particularly in European contexts, the inclusion of 'smart' technologies within energy technologies has often coalesced around ideas of greater user participation and engagement in energy projects (Ballo, 2015), this is not universal. Indeed, as will be explored in this thesis, many ideas around 'smart' in rural India specifically involved the removal of control structures from users themselves. The 'smart' iteration of rural energy

access has been garnering significant investment and excitement in the Global South off-grid sector (Nagpul & Parajuli, 2019). In practice, 'smart' technology within off-grid systems primarily revolves around intensive data usage to monitor system diagnostics (voltage and current levels, system faults, energy flows), energy consumption patterns and external variables (temperatures, insolation, etc.). Academics, practitioners and government policy makers, including those involved in SolarFuture, are committed to the idea that 'smart' grids will catalyse wider development and 'smart' transitions (Somwanshi, et al., 2016).

The 'smart' movement is not without critiques, some of which will be explored in this thesis. Amongst others, the data intensive practices associated with it have raised concerns globally about security and surveillance (Gladon-Clavell, 2013). The techno-centric preoccupation of the 'smart' movements has been critiqued for overlooking and depoliticising social structures (Kitchin, 2016). Smart cities in particular have been criticised for their potential lack of inclusivity, which could exacerbate existing justice issues (Hoelscher, 2016). The term 'smart' primarily refers to the technical components of a system, though there have been calls to widen this definition (Kumar, 2019a). Its orientation around the technical capabilities of a system not only reflects the priorities of the designers of such systems, but also serves to generate specific types of knowledge and understandings of the systems themselves. The data collection components of 'smart' energy systems primarily revolve around discrete, quantitative measurements of inflows and outflows. While this can elucidate detailed insights into how people live their lives and minute details of their energy usages (Batra, et al., 2013), it also serves to obscure other types of knowledge about how people interact with such systems. The 'smart' data was central to establishing a specific set of understandings around it, but which excluded the understandings of those using it.

1.3 Limits of Micro-Grid Studies

My own personal engagement with off-grid energy and micro-grids in India began when I moved to South India to work in a social enterprise/NGO working in solar energy immediately after finishing my undergraduate engineering degree. I worked in the organisation's rural development team, who were tasked with developing and implementing solar projects that could help to tackle some of the most pressing issues in villages in the South Indian state of Karnataka. The projects ranged from community scale micro-grids (not unlike the one studied in this thesis) to solar pumping and agro-processing, solar DC chapati making machines, solar powered community health centres and solar reverse osmosis (RO) water filtration systems,

amongst many others. This was in addition to solar home lighting systems, solar street-lighting and solar community charging points which were sold in communities across the region. My colleagues and I would travel around the state on the directions of our organisation and visit villages to undertake 'needs assessments', with the aim of finding problems that solar energy could 'fix'. We would then work with local institutions and government groups, local communities and donor organisations to attempt to design and implement whichever solar-based intervention had been conceived.

The experience was a fascinating opportunity to visit and learn about the lives, challenges and opportunities of those living in rural Indian villages, particularly while working alongside some highly knowledgeable and experienced colleagues. Equally, it gave me first-hand experience in the Indian 'solar sector', engaging in many of the discourses, discussions and contemporary debates into how renewable technologies were expected to mobilise sustainable change. Of these, some of the most passionate and excited conversations were taking place around the burgeoning micro-grid movement, which was seen as the next step in providing rural electricity that could be more flexible, sustainable and reach higher capacities than previous iterations of off-grid energy.

However, it was also through this experience that I started asking questions about the social structures and politics of what we were doing, which ultimately went on to underpin my PhD research questions. Some of my Indian colleagues (who, like me, were in low ranking, 'field level' positions) and I would ask ourselves what the aims of the projects we worked on were, as the development logics around them sometimes seemed flawed. We began to wonder whether we cared more about installing widespread solar PV than about what it might achieve, unclear of the end goals in the projects we worked on. It became increasingly clear that there were inconvenient politics around caste, gender and class structures in these projects, that were being systematically overlooked in discussions about the technical, financial and logistical components. We were often frustrated that we were never able to spend significant periods of time in the communities we worked in, and thus were unable to fully understand the perspectives on and reactions to the projects we installed, nor were we able to understand the nuances of the politics around them.

Many of the concerns that my colleagues and I had are reflected in the growing body of social science based enquiry into off-grid energy systems. However, there are also elements of the approaches taken in the off-grid solar sector that are sometimes perpetuated within

academic engagements in off-grid energy, and which could be usefully challenged. This thesis hopes to contribute a grounded, in-depth investigation into the details and nuances around one specific case study, to explore the complex and intersecting politics around a micro-grid project, *without* a normative investment in what the system *should* be achieving or how its technical components *should* function.

This subsection explores the limitations in our understandings of micro-grid systems, as being sometime overly technocentric, reliant on normative expectations of micro-grid systems and having a predominantly impact-oriented focus.

This thesis does not engage to a great extent with the literature focusing on micro-grids or smart energy systems in the Global North, instead building on analyses within more comparable contexts, particularly those coming from other post-colonial contexts. The concept of the micro-grid has gained traction in numerous contexts globally, from remote communities off the coast of Scotland (Scott, 2016) to urban hubs in New York City (Mengelkamp, et al., 2018). However, beyond the material technologies themselves, these largely operate within vastly differing paradigms and have differing power structures around them. Drawing significant comparisons or conclusions from the Global North's engagement with micro-grids would therefore be largely unhelpful, particularly given the depth of contextualisation explored in this thesis, but might also reinforce dominant understandings of energy and smart technology stemming from the Global North. This thesis engages to a greater extent with the study of micro-grids centred around developmental contexts, particularly those in South Asia.

The study of energy has often been dominated by technical disciplines, particularly engineering and economics, with numerous calls for increased social science engagement and particularly a focus on qualitative methods (Sovacool, 2014; Winther & Wilhite, 2015). The majority of discussion around solar micro-grids, alongside off-grid energy more generally, has also been dominated by technical analysis. The technocentric focus of the study of micro-grids leaves a significant gap for understanding the socio-technical components of such systems and their implications (Ulsrud, et al., 2011). Equally, the technocentric focus of micro-grids, particularly within the developmental discussions explored earlier, runs the risk of ascribing specific development outcomes to these projects. Within this thesis, I use Madeleine Akrich's concept of the 'scripting' of technical objects (Akrich,1992), whereby systems are designed with specific intended uses or outcomes built

into them by their designers, as a means of understanding these tendencies. Arguably, this links to the tendency for development actors to 'problematise' structural and systemic issues based on actionable solutions (Escobar, 1995). This has been usefully conceptualised within the development and technology space as the 'technologizing' of development issues (Abdelnour & Saeed, 2014) and critiqued as a form of 'technosaviourism', where technologies become a solution to all development issues as opposed to one of many interventions (Abdelnour, 2015). This emphasises the imperative to include grounded, qualitative analyses in the study of micro-grids, in order to understand the implications of such systems within wider developmental contexts. While my background as an engineer influenced my initial engagements with the sector, as is explored in more detail in chapter 2, this thesis situates itself within qualitative social sciences, drawing from interdisciplinary influences.

A significant body of literature on micro-grids moves away from the purely technical design and development aspects, to look at the wider components which facilitate them. These components include, but are not limited to, their governance structures (Palit & Sarangi, 2013; Gollwitzer, et al., 2018; Katre, et al., 2019), pricing and tariffs (Palit, et al., 2014; Sachiko, et al., 2018), repair and maintenance planning (Chaurey & Kandpal, 2010; Palit & Malhotra, 2015) and business models (Schillebeeckx, et al., 2012; Engelken, et al., 2016; Pedersen, 2016; Scott, 2017). There is also a significant body of literature seeking to understand the role of micro-grids in achieving rural electrification. These engage with policy environments (Soshinskaya, et al., 2014; Urpelainen, 2014), large scale financial viability (Raman, et al., 2012), interactions with grid power (Molyneaux, et al., 2016; Bhattacharya, et al., 2019) and marketisation of scaled micro-grid models (Singh, 2016).

These bodies of literature engage with explicit actionable approaches which focus on reforming and improving policy around micro-grids and providing new approaches to design and implementation that overcome the challenges that are addressed. These fit within global mandates to solving global challenges around lack of electrification and concerns around sustainability (World Bank, 2017). They primarily engage with off-grid energy in tangible, measurable terms, focusing on the quantity and quality of power available, often compared directly with grid supplied energy. There is a gap here to explore alternative framings of what micro-grids mean and the values, symbolisms and expectations taken from them (Winther & Wilhite, 2015).

A consequence of the somewhat normative approach taken to understanding micro-grids is that academic attention often focuses on the technical, logistical and financial challenges of barriers to making micro-grids 'work'. This precludes more deconstructed analyses of what it would mean for them to 'work' or, indeed, the multitudes of perspectives on what 'working' might actually mean to different people (Ahlborg, 2018). These approaches rarely, if ever, leave space to explore how micro-grids are perceived by those using them or how they relate to wider politics. The combined consequence of the often technocentric and normative perspectives taken in researching micro-grids in some ways serve to de-politicise the micro-grid as a tool for development, reminiscent of critiques of wider development practices (Ferguson, 1994), and make it harder to engage with the wider social politics which shape its design, implementation, usage and end of life (Ahlborg, 2018).

Sometimes included within this is the normative separation of the end users, often referred to as 'the community', and 'the implementors', comprised of engineers, designers, entrepreneurs and state actors among others. Admittedly, within this thesis I also fall into these binaries, not least because they provide useful languages for describing the roles and positions of individuals and groups; however, there is a need to deconstruct and examine this further (Campbell, et al., 2016). The idea of a homogenous 'community' of end users can be critiqued, particularly as we engage with the internal power structures which create a multitude of experiences in response to energy innovations (Ahlborg, 2017; Kumar, 2018). Equally, however, this thesis makes attempts to engage with the engineers within the system and state actors around it as being part of the wider set of 'communities' around the micro-grid. Alongside this, it aims to explore the role of the village community in engaging with the shaping of the micro-grid, thus blurring the lines between 'designer' and 'user' and acknowledging the larger role of energy users in participating in micro-grid systems. However, in order to understand the micro-grid, there is also a potential need to disaggregate actors in terms of the different audiences they appeal to. For instance, the engineers in the micro-grid interacted with the user community, but also curated an external image of the system that was used to mobilise access to funding, media attention and to leverage powerful relationships. This is explored in more detail in chapter 7, which looks at the 'charisma' around the micro-grid system.

Aside from academic work looking at how to facilitate micro-grids, a number of the analyses of micro-grid systems from a social perspective take an impact focus. In and of themselves,

this provides us with a valuable understanding of how micro-grids affect communities and the extent to which they fulfil development mandates. Examples of this include the impact of micro-grids on rural development (Kirubi, et al., 2009; Azimoh, et al., 2016), on employment and income (Urpelainen, 2016; Aklin, et al., 2017; Pueyo & DeMartino, 2018), on social development (Millinger, et al., 2012) and on gender relations and women's empowerment (Winther, et al., 2018). These fit within the wider studies of impacts of grid electrification (Kanagawa & Nakata, 2008; Winther, 2008) and the impacts of other solar PV interventions (Nieuwenhout, et al., 2001; Mondal & Klein, 2011; Buragohain, 2012). Within the impact focus, there are valuable conclusions to be drawn about the implications of micro-grids on local communities. These are critical for understanding the role (or not) of micro-grids within energy futures and transitions, though they also need to be taken with caution and awareness of their contextualisation (Ulsrud, et al., 2018) and limited ability to understand long term impacts (Winther, 2015). There needs to be an acknowledgement of the complex and non-linear processes by which development outcomes are influenced by any energy access (Matinga & Annegarn, 2013; Ahlborg, 2018) to avoid falling into technologically deterministic assumptions. There is also a potential for impact focused analyses to fall into normative assumptions of what micro-grids *should* be achieving, particularly when aligned with the scope of the development goals which are inscribed into such systems (Winther, 2015).

There is both a gap and an opportunity within the study of micro-grids to explore more of the subjectivities in how people to respond to such systems, within a wider social and political context. Equally, a gap left by the impact focus of the studies of micro-grids rarely frames user communities as active participants in shaping projects (Kline & Pinch, 1996; Wilhite, 2008). It does little to acknowledge the flexibilities within such technologies (Ahlborg, 2018). Greater engagement with science and technology studies (STS) approaches within the study of the social construction of such technologies could provide insight into the social politics around them and the more complex processes of change associated with them (Bijker, et al., 1987). This should position the users of such systems as both being impacted by them, but also having impact and an active role in shaping them.

1.4 Social Structures and Politics of the Micro-Grid

This thesis uses terminology around the social politics and socio-political processes to engage with the relationships and negotiations around power and control in the micro-grid system

(Ahlborg, 2017), at the intersection with social structures, particularly those pertaining to gender, caste and tribe. It aims to engage with the processes, development logics and decision making around the micro-grid as being political (be that on a localised level), alongside being technically and economically driven. This section will explore some of the key overlapping and intersecting ways in which the micro-grid could be conceptualised, which will be built upon further throughout the chapters in this thesis.

The micro-grid could be understood to be politicised in numerous ways, which can be usefully explored by drawing on existing ideas around the politics of development, technology, infrastructure and energy. Part of this multiplicity is in how the micro-grid could be conceptualised in numerous different ways, particularly with reference to more 'conventional' larger grid energy systems.

These could include, but are not limited to: conceptualisations of the micro-grid as an alternative type of infrastructure, more akin to its large scale grid equivalent (Cook, 2011); as a marketable product or service (Singh, 2016); as a technology or technological object, such as an extension of its smaller, off-grid solar counterparts (Cross, 2013; Sen & Bhattacharyya, 2014); as a common pool resource (Wolsink, 2012; Gollwitzer, et al., 2018); as a set of institutional relationships adhering around the material form of the micro-grid (Wolsink, 2013); as a development 'project' in and of itself (Kirubi, et al., 2009); or something much more symbolic and intangible. The intersection of micro-grids with state and non-state actors, environmental geographies and localised social structures add depth and complexity to these conceptualisations. Most studies of micro-grids have, either implicitly or explicitly, engaged with them as a combination of these conceptualisations. Several authors have utilised socio-technical systems theory as a means to understand micro-grids (Ulsrud, et al., 2011; Ahlborg & Sjöstedt, 2015). This draws from 'seamless web' acting within the social and technical components of such systems (Hughes, 1986; Bijker, et al., 1987), which has been used particularly to conceptualise larger infrastructural networks, including large scale electricity networks. The framing of socio-technical systems within analyses of sustainability transitions has opened up a range of opportunities to engage with the power dynamics and politics in such transitions (Avelino & Wittmayer, 2016; Ahlborg, 2017) and, as such, will be reflected in this thesis.

STS and anthropological literature on infrastructures provides valuable perspectives from which to understand the political processes associated with energy systems. There are

numerous different ways in which infrastructure has been conceptualised (Larkin, 2013), which have varying levels of relevance in the micro-grid context. The entanglement of energy with the structures of state power has been explored to varying degrees within numerous different contexts, and has predominantly focused around the paradigm of large-scale traditional electricity grids.[3] These studies have engaged with "material politics of electricity flows through state power" (Boyer, 2015, p. 532). These include Sunila Kale's examination of the political economies of the Indian electricity grid since Independence (Kale, 2014), Antina von Schnitzler's engagements with the technopolitics of electricity metering infrastructure in post-apartheid South Africa (Von Schnitzler, 2016) and Marcus Power and Joshua Kirshner's examination of the extension of state authority and the creation of neoliberal subjectivities within electrification projects in Mozambique (Power & Kirshner, 2018). This literature paints a powerful picture around how state power intertwines with the material infrastructures associated with the generation, delivery and consumption of electricity. Dominic Boyer and Cymene Howe's work on wind power in southern Mexico particularly highlights the contested components of sustainability transitions within these politics, as they intersect with multiple subjectivities and versions of political materiality (Howe, 2014; Howe & Boyer, 2015).

If the electricity grid acts as a form of state power, as much of this literature argues, it is pertinent to ask what happens in the context of the 'off-grid' and to understand what the off-grid context can learn from these politics. In some sense, the off-grid is shaped in itself by structures of marginalisation, and potentially an absence of state care (Cross, 2019a). The intersecting politics of the grid in India are often characterised by colonial legacies, corruption, electoral politics, bureaucracy and inefficiency, alongside widespread electricity theft (Kale, 2014a). In Odisha, as with other eastern Indian states, the politics around the grid are intertwined with both the politics of resource extraction and of marginalisation (Kale, 2014a, ch. 4; Chandra, 2018), which lead to unelectrified communities living alongside some of the country's most productive mining facilities (Cross, 2019a). Electrification rates intersect with wider structures of marginalisation; those from marginalised groups,

[3] Of note, though largely beyond the scope of this thesis, is Timothy Mitchell's *Carbon Democracies* (Mitchell, 2011). This explores the interplay between fossil fuels and democratic politics on a state and global level. There are interesting opportunities to explore solar PV energy and micro-grids through this lens, for example, in examining the extraction, flows and consumption of materials required for the manufacture of solar systems, such as lithium for batteries (Sun, et al., 2017; Newell & Mulvaney, 2013).

particularly lower caste, Dalit, Adivasi[4] and minority religious groups, are disproportionately less likely to be connected to the grid (Kemmler, 2007; Oda, 2014). Thus, the politics of the off-grid becomes deeply intertwined with the political economies of state and societal structures. From the perspective of the individuals, households or communities using the grid, there is also the key aspect of what the electricity grid promises and how that shapes who and what people are with relation to the state (Balls & Fischer, 2019) and understandings of development more widely. This engages with the versions of modernity promised by the arrival of the electricity grid in James Ferguson's work on Zambia (Ferguson, 1999) and in Tanja Winther's work on Zanzibar (Winther, 2008), both of which speak to the power of electricity to shape expectations of a type of modernity, which are potentially realised in unexpected ways. When intersecting with wider societal structures, the unequal provisioning of grid and, by extension, modernity, become even more deeply politicised.

However, there are also perspectives on the off-grid which challenge these views. Kale explores the Indian colonial leader's views of the extension of the grid, citing Gandhi as expressing concern over the grid as a means to consolidate power in the centre of government, jeopardising localised agency, in direct contrast to the aims of Jawaharlal Nehru to achieve centralised power as a means of state building (Kale, 2014a, p. 28). Within this, off-grid energy has, at points, been associated with a democratised, decentralised version of electricity provision (Koirala, et al., 2016; Warneryd, et al., 2020; Hirsch, et al., 2018); a way to subvert and undermine the state power materialised through the grid. Either way, the technologies which step into the void created in the absence of state provided grid are inevitably shaped by the politics of the grid.

A theoretical lens proposed to understand the implications of these politics in the sense of control over energy and electricity, and by extension, people, is Dominic Boyer's 'energopower', which builds on the Foucauldian concept of 'biopower', to conceptualise "a genealogy of modern power that rethinks political power through the twin analytics of electricity and fuel" (Boyer, 2014, p. 325). This concept, while predominantly applied to versions of state authority, arguably also has applications in the off-grid sector, where the power that electricity and energy have over people's lives becomes controlled by a new set

[4] This thesis refers to individuals from indigenous tribal communities using the term Adivasi, as was used as a term of self-identification by people I spoke to, occasionally along with the name of the specific tribal group. By others, such as state officials, engineers and NGO staff, this term was used interchangeably with ST (Scheduled Tribe) and 'tribals'.

of actors, equally embedded within wider societal hierarchies and structures of power, influence and control (Ulsrud, et al., 2011; Ahlborg, 2017). While the nuances of this Foucauldian analysis are not engaged with directly to a large extent in this thesis, the integration of systemic power structures within the understanding energy systems is central to understanding the micro-grid within its context.

This thesis explores many of these dynamics and perceptions of the micro-grid with relation to the state in chapters 3 and 5. It highlights the perceptions by some, particularly higher caste men, of the absence of grid as indicative of an absence of state care and inclusion and unmet expectations of modernity and development. Chapter 4 argues that the off-grid technology acted as symbolic representation of this absence. However, it also acknowledges that this was not the case for many who have historically been marginalised by the state, for instance, Adivasi women. It also explores the ways in which the micro-grid engaged with the binary state versus non-state provision of electricity, but also meant appealing to private sector actors for provisioning of electricity. The implications of the forest context are particularly relevant, and are explored in chapter 5, where a different type of state-community relationship intersected with the micro-grid in surprising ways that challenge many of the 'sustainability' narratives around the micro-grid. Ultimately the forest and the state both become actors in the processes of disassembly and reassembly of the micro-grid assemblage.

1.4.1 Social and Political Landscape

Much of the social politics critical to understanding the micro-grid are rooted in the social politics of its context and actors, which play a critical role in shaping the evolving form of the technology as well as underpinning any responses to it. Much of this is built upon throughout this thesis, and chapter 2 provides a much more detailed introduction to those within Urjapur itself. Themes of gender, caste and tribe occur frequently throughout this thesis and, along with religious divides, are all critical underpinnings to the politics around any development processes in the South Asian context (Shah, et al., 2017).

The state of Odisha is often characterised by its perceived marginality and has, by and large, received comparatively little academic attention compared with other regions of India (Sengupta, 2015). While coastal Odisha is famous for its beaches and temples, with the Jagannath temple in Puri attracting pilgrims and visitors from across India, the state as a whole is more often renowned for its poverty levels, 'backwardness' and vulnerability to

cyclones. Odisha, along with its neighbours Chhattisgarh and Jharkhand, is often named specifically as one of India poorest states, with low development indicators for child development, health and food security (Drèze, 2017). Odisha has an abundance of natural resources, with coal and bauxite mining forming significant parts of its economy. However, the benefits from this remain poorly distributed, with low investment in social welfare systems (Kale & Mazaheri, 2014). This has been blamed to an extent on a lack of lower caste mobilisation in reforming state politics (Jaffrelot & Kumar, 2012) and a political dominance of higher caste Brahmins from coastal Odisha (Mohanty, 1990; Harriss, 1999). Despite having an overwhelmingly rural population, heavily dependent on agriculture, the state has also largely neglected this sector in its development strategies, instead focusing on private engagement in extractive and production industries (Das & Nayak, 2018). In addition to this, there are disparities around infrastructure and welfare provision across the state, which disproportionately impact certain groups and populations (Sengupta, 2015).

Western and southern Odisha are home to significant populations of Adivasis, from indigenous tribal groups. Around half the households in Urjapur identified as Adivasi. Adivasi politics in particular adds a critical component to this context. Adivasi communities have historically been marginalised and alienated, being framed as 'primitive', 'backwards' or 'uncivilised' in mainstream discourse (Munshi, 2012). Across eastern India, Adivasis are disproportionately displaced for development projects (including dam and mining projects) and, as is particularly pertinent to this thesis, are overwhelmingly impacted by forest conservation measures (Baviskar, 1994). Despite their indigeneity to the land in which they live, Adivasi groups are often characterised as trespassers with few formal rights (Munshi, 2012). This has been explicitly demonstrated most recently with the 2019 Supreme Court ruling on the 2006 Forest Rights Act, which threatens the rights of several million Adivasi people living in protected conservation areas (The Guardian, 2019). Displacement and the destruction of livelihoods are seen as some of the key issues facing Adivasi communities. The ongoing oppression of the rural poor, including Adivasi groups, is seen as one of the mobilisers for the Naxalite Maoist insurgency in the region (Guha, 2007). However, on localised scales there is additional nuance and complexity required when engaging with these issues. Alpa Shah's book, *In the Shadows of the State: Indigenous Politics, Environmentalism, and Insurgency in Jharkhand, India*, provides a detailed and nuanced analysis of the contentions around indigenous politics and development projects, as they engage with localised structures, environmental conflicts and the Maoist insurgency (Shah, 2010).

One key structure underpinning this context, and intersecting other social structures, are the colonial legacies, impacting in the structures of forest management, in the lack of infrastructures in much of Odisha and in the forms of gender, caste and tribal structures in the context. This legacy has clear implications for the formation of, experiences of and access to the grid (Coleman, 2009; Kale, 2014b). However, in depth exploration of this is, by and large, beyond the scope of this thesis. References are made to this at points through this thesis, particularly when it arose during interviews with older community members, often with reference to the forest.

Alongside and intersecting with the politics of caste and tribe, the politics around gender and gender inclusion are critical to understanding engagements with and implications of the micro-grid. Gender is a key focus of discussion within many of the development movements in South Asia (Sharma, 2008), and remains a contentious and important issue which is central to understanding the processes around the micro-grid. More specific detail around the gender structures in this context, as well as its role in the methodologies used in this thesis are provided in chapter 2.

There are numerous lenses which could helpfully contribute to understanding these gender politics, such as the development studies literature around empowerment (Kabeer, 2005) and capabilities (Sen, 1989; Nussbaum, 2000; Fukuda-Parr, 2003). Alongside this, there is a growing body of literature which explores the nexus of gender and energy, particularly as it is experienced in the Global South (Cecelski, 1995; Parikh, et al., 1999; Pachauri & Rao, 2013), alongside calls for energy policy to move away from gender-blind approaches (Kelkar & Nathan, 2005). Within the study of gender and energy there has been significant focus on non-electrical energy usages, particularly for cooking and their impact on women, as opposed to on gender relations (Malhotra, et al., 2004; Parikh, 2011; Kumar & Mehta, 2016). There have been valuable engagements with the impact on electrification on women's empowerment (Winther, et al., 2016), on the impact of productive energy usage on women (Pueyo & Maestre, 2019) and on the shifting gender relations around energy access and care work (Standal & Winther, 2016), and in decision making patterns (Winther, et al., 2020). The breadth of work existing around gender and energy speaks to the importance of gender structures in understanding energy. This needs to be carefully contextualised, however, and acknowledged at the intersection of other social structures (Kapilashrami, et al., 2015), such as those around caste and tribe.

This thesis primarily utilises approaches from feminist technology studies as a means to conceptualise and engage with the politics around gender and the micro-grid (Wajcman, 2010). This facilitates understandings of not just the gendered components of energy uses, but also the implications of wider social structures on the formation of these technologies (Bray, 2007). This serves to expand the understanding of gender within micro-grid projects to acknowledge the gendered components of its design and conception, which particularly enables gendered constructions of the technical design and policy narratives. Gender relations across the micro-grid assemblage also become critical parts of the processes of disassembly and the remoulding of the micro-grid, particularly in efforts to decentre the system from its initial conception.

1.5 Terms of Critique

My aim within this thesis is to deconstruct the meanings, politics and processes embodied within the micro-grid at its conception and to make sense of new, remoulded and re-formed understandings of these deconstructed parts. As a starting point, I conceptualise the Urjapur 'smart' solar micro-grid using assemblage theory (Ong & Collier, 2005). Development studies, social anthropology, geography and other disciplines have utilised assemblage approaches to understanding global development structures, policy and practices and their interactions with local contexts (Tsing, 2005; Ong, 2006; Sharma, 2008; Gidwani, 2008; McFarlane, 2009). Within this thesis, this approach enables me to embrace and explore the complexity and messiness of the technologies, actors, ideologies, relationships, politics and aspirations which coalesced around the micro-grid, interlinking global discourses with localised realities. This grounding engages with trends, as described by George Marcus and Erkan Saka, to "focus of attention in research about social process and cultural meaning on the ephemeral, the emergent, the evanescent, the decentered and the heterogeneous, all the while not giving up on a long-established commitment to account for the structured and systematic in social life" (Marcus & Saka, 2006, p. 101). Tania Murray Li utilises assemblage thinking as a way to acknowledge agency, and "the hard work required to draw heterogeneous elements together, forge connections between them and sustain these connections in the face of tension. It invites analysis of how the elements of an assemblage might – or might not – be made to cohere" (Murray Li, 2007, p. 264). Kevin Grove and Jonathon Pugh describe the assemblage, with relation to participatory development, as "less a *thing* with defined borders and a clear identity than a *process*: a continual de- and re-composition that is only ever

partially stabilized" (Grove & Pugh, 2015, p. 2). This framing of an assemblage as being shifting and evolving process is critical to this thesis, which primarily focuses around the deconstruction, disassembly and in-cohering of the micro-grid assemblage.

Anthropology-based engagements with energy and electricity are also fundamental to framing this thesis, in both informing the methodological approaches, as well as the foundational empirical and theoretical lenses it builds upon. Anthropological approaches provide frameworks through which to acknowledge the vast breadth of impact that electricity can have, far beyond specific, measurable development criteria. Tanja Winther and Harold Wilhite outline anthropology's engagement with electricity as follows:

> "Electricity's arrival in new places initiates a complex interaction between local ways of doing things and the multiple potentials for change that electricity brings. This interaction infiltrates virtually all of the traditional subjects of anthropology: senses of place; perceptions of risk; discourses of modernity; community and household practices; rituals and ceremonies; local economy and politics; and social relations of various kinds, from citizenship, kinship, and gender to generational dynamics and people's relationships with occult forces."
>
> (Winther & Wilhite, 2015, p. 570)

A grounded approach to understanding how people engage with the micro-grid enables an ability to step away from the norms and expectations which have previously been ascribed in such systems and to engage with alternative understandings of electricity and off-grid energy than those provided by technical disciplines (Abram, et al., 2019). This thesis takes inspiration from Winther's ethnography on the coming of the electricity grid in Zanzibar (Winther, 2008), in its attempts to provide an in-depth and nuanced understanding of a single micro-grid site. While, admittedly, my presence in the community was because of the micro-grid, this thesis attempts to situate the micro-grid within an existing community who were not entirely defined by this technology, at least in how they viewed themselves. It seeks to embrace the wider context of the village as a complex and dynamic community, where the micro-grid, while central to this thesis, was only one of many aspects of life there. My primary aim from the outset of this project was to seek to understand micro-grids and the places where they are installed through the perspectives of the people experiencing them and life around them. Ethnographic methods, particularly embedded within feminist methodologies (Reinharz & Davidman, 1992), gave me the greatest opportunity to do so. This thesis aims to

ground itself in the conversations I had within the community and within the conceptualisations the community members had of the micro-grid and the ideas around it.

In line with numerous other studies of off-grid energy systems (Ulsrud, et al., 2011; Ahlborg & Sjöstedt, 2015), this thesis utilises the theory around socio-technical systems (Bijker, et al., 1987) to situate the analysis of the social nuances within the technical formation of the micro-grid and to engage with the developmental logics alongside the technocratic imaginations of energy futures (Cloke, et al., 2017). This thesis is informed by constructivist approaches to understanding technology, engaging with literature and concepts on the social shaping of technology (Pinch & Bijker, 1987; Williams & Edge, 1996). This moves away from the 'hard' technological determinism associated with cause-and-effect impact studies of technological change (MacKenzie & Wajcman, 1999). Instead, this thesis looks to understand the ways in which communities surrounding the micro-grid shaped and moulded it. This provides an opportunity to explore the politics of the communities and the context in this shaping process (Sharma, 2020). The concept of 'scripting' technical objects, as proposed by Akrich in *The De-scription of Technology Objects* (Akrich, 1992), is used to understand the role of the engineers in the systems in inscribing specific values, imaginations and ideologies with the design of the system, and ideas of de-scription are useful in conceptualising how meanings, uses and ideologies serve to remould the technology. As described by Maria Lohan with reference specifically to feminist technology studies, "Constructivist approaches to technology understand technologies as being non-essentialist - as not what a technology is but rather what it becomes or 'means' to people in different contexts" (Lohan, 2000, p. 909). These ideas are central to this thesis particularly in its attempts to reconceptualise and decentre the micro-grid from the perspectives of the multitude of actors around it. Theory around gender and technology (Bray, 2007) has also been useful in understanding the developments around the Urjapur micro-grid and in understanding the social structures which are embodied within the assemblage around the technology.

1.6 Critique

The framing of the micro-grid as an assemblage provides a useful lens for embracing the 'messiness' of the micro-grid and its intersections with an array of global and national discussions and with a range of actors. In this thesis I seek to understand how the micro-grid assemblage is received and engaged with in the local Urjapur context. I focus on the processes of disassembly and reassembly to understand how the micro-grid is remoulded

and reimagined. Tania Murray Li provides a systematic analysis of the processes by which development assemblages form and are adhered, citing “forging alignments”, “rendering technical” and “anti-politics” as part of the processes which form and adhere assemblages (Murray Li, 2007, p. 266). I would argue that these components have relevance to the micro-grid, where, as discussed previously, development challenges become both ‘technologized’ and their ‘solution’ de-politicized by their proponents. From my fieldwork, however, this thesis explores the processes which dislocated alignments, rendered the technical un-technical and which politicised the micro-grid *in situ*.

This thesis argues that the micro-grid was constantly being critiqued, remoulded, appropriated, resisted and disassembled, primarily by those using it but also by those designing and controlling it and by other actors in the region who had a stake in the system. This relates both to the material technology, in the common-place sense of disassembly, but particularly here about the relationships, negotiations and ideologies operating within this system.

In *The de-scription of technical objects,* Akrich describes the processes by which technical objects are ‘scripted’ by the designer:

> “Designers thus define actors with specific tastes, competences, motives, aspirations, political prejudices, and the rest, and they assume that morality, technology, science, and economy will evolve in particular ways. A large part of the work of innovators is that of *“inscribing”* this vision of (or prediction about) the world in the technical content of the new object.”
>
> (Akrich, 1992, p. 208)

Within this context, this provides a good lens through which to view the visions and aspirations built into the micro-grid design, as outlined in the BBC article. This also encapsulates the values and biases inscribed into the technology. In the case of the Urjapur micro-grid, this particularly relates to the gendered norms and expectations inscribed in the micro-grid design and control (Berg & Lie, 1995), as well as their intersections with caste, tribe and class divisions. These are inscribed into the technology, but also into the narratives and policy decisions in the sector as a whole. Akrich extends her concept of ‘scripting’ to look at the processes of ‘de-scription’ as a means to explore the alternative uses, meanings and relationships within technology that move away from those inscribed by the designer. She emphasises the need to “go back and forth continually between the designer and the user,

between the designer's projected user and the real user, between *the world inscribed in the object* and *the world described by its displacement.*"(p. 209). This has applications in the Urjapur context, where the affordances (Gibson, 1979; Hutchby, 2001) envisaged by the entrepreneur and designer of the system existed alongside numerous other affordances which were formulated not only by those in the community, but also by state actors working in the area and by other developers of micro-grids working across state. This thesis concerns itself with understanding this interplay between the initial design and the real users. It argues that when expanded to view the wider socio-technical assemblage of the micro-grid, this is central to understanding its role and implications in the communities in which it is installed.

A way to understand these processes is to engage with conceptualisations of *jugaad* or the Odia language equivalent, *jogad*[5]. The term is frequently used across South Asia to refer to the process of arranging things, people and situations to 'make do' (Rangaswamy & Densmore, 2013; Jauregui, 2014). *Jugaad* as a wider concept has a role within conceptualisations of technology and innovation in India, evoking images of ingeniously and sometimes ridiculously repaired or re-engineered vehicles, machines and other solutions often termed as 'frugal innovation' (Radjou, et al., 2012). The meanings of *jugaad* have shifted as the concept has been appropriated and romanticised by the business governance and development worlds (Kaur, 2016), as well as being intertwined with neoliberal and nationalistic narratives of *jugaad* as a uniquely South Asian problem-solving practice acting as a counterpoint to Western-centric conceptions of innovation (Prabhu & Jain, 2015). For many, the capacity for Indians to *jugaad* solutions to challenges brings an opportunity for India to harness its entrepreneurial spirit and compete on a global stage and to empower working class Indians to emancipate themselves through innovation (Radjou, et al., 2012; Kaur, 2016). Equally, the glorification the phenomenon has its critics. For some, the very existence of *jugaad* is inherent of a system with extreme inequality and material insufficiency (Prahalad & Mashelkar, 2010; Jauregui, 2014) and embodies systemic risk (Birtchnell, 2011) and implies questionable legality (Jeffrey & Young, 2014; Jauregui, 2014). These critiques

[5] I am primarily using the Odia word *jogad* in this analysis, which, in practice, has the same meaning as the Hindi *jugaad*. While relating to wider, pan-South Asian ideas, it is important to acknowledge that Odisha (particularly non-coastal Odisha) has been, and continues to be, politically, academically and linguistically marginalised (Sengupta, 2015). Wider social and geographical phenomena very much played into the events, relationships and practises outlined here, but many were also inherent of Odisha as a peripheral region. Thus, as part of a deliberate attempt to avoid contributing to Hindi-dominant analyses and to respect the cultural and linguistic identities of Odisha in its their own right, where appropriate Odia words are used over the Hindi equivalents.

assert the inherent instability, precarity and power inequity in *jugaad* that have valid applications in development contexts such Urjapur and are central to understanding any processes of *jogad* with reference to the micro-grid. *Jogad* is an important lens through which to explore the micro-grid, and the power dynamics embodied within it (Jauregui, 2014). It goes beyond providing a framework to understand an isolated process of disassembling or deconstructing of the micro-grid assemblage, to engage with a productivity in the processes and outcomes of reassembly. It suggests attempts to decentre the micro-grid assemblage from its original 'script', towards a reassembly that provides uses, ideologies and ideals that are seen as more helpful to those undertaking it. The concept of *jogad* is, therefore, useful in this thesis as a way to move away from normative expectations or designs of energy usages, particularly those which place the technology as immutable and its users as at fault (Crewe & Harrison, 1998).

Some authors have drawn parallels between the ideas around *jugaad* and Levi-Strauss's concept of *bricolage* (Sekhsaria, 2013; Prabhu & Jain, 2015). The ideas around *bricolage* have been usefully employed to understand development processes and the ways in which communities accept, reject or appropriate and adapt external interventions, for instance, in Frances Cleaver's work on critical institutionalism (Cleaver, 2012; De Koning, 2014). In Cleaver's work, Levi-Strauss's framing of intellectual bricolage as the idea that people "creatively draw on heterogenous repertoires in their thinking, combining and reordering" (Cleaver, 2012, p. 33), is used to understand how natural resource management projects are received within community structures. This explores the "complex social identities, unequal power relationships and wider political and geographical factors" in understanding how people respond to external interventions, particularly emphasising the role of agency within wider structures (Cleaver & De Koning, 2015, p. 4). These ideas could be gainfully applied to understandings of *jugaad* in the context of the micro-grid, which relate not just to processes of innovation, but also to structures of power and the ways in which communities, groups and individuals practice *jugaad* and appropriate power and agency over development interventions. This idea of appropriation as a process is a key component in understandings of the role of users of technologies within social shaping of technologies frameworks (Mackay & Gillespie, 1992).

Concepts of improvisation and *jugaad* around off-grid has been explored to some extent with respect to off-grid energy, particularly with reference to the physical adaptation to the

technologies themselves (Kumar, 2019b). Improvisation also arises within the context of user participation in energy systems (Ornetzeder & Rohracher, 2006; Abi-Ghanem & Haggett, 2010). This mode of adaptation within the configurations of socio-technical systems associated with sustainable transitions has been described by Helene Ahlborg, in relation to social construction of technology literature:

> "Importantly, the configuration is dynamic, as local conditions, wilful users and changing circumstances tend to modify, reinterpret and contest the prescribed 'proper' use of technologies and reconfigure the system (Bijker & Law, 1992). Also when power is embedded in infrastructure it evokes responses and counteraction. This indicates that *mediation* also is at the core of human—non-human interactions. In other words, the 'script' is rewritten as it is played out (Akrich, 1992), again and again in the ongoing encounters between humans and things."
>
> (Ahlborg, 2017, p. 128)

The inclusion of ideas of power within the adaptation of systems evoke ideas around 'contestation' and 'negotiation' that are helpful in engaging with the politics of such systems, beyond the material adaptation. Within the South Asian context, there are alternative framings of *jugaad* that are helpful in this regard. In parts of India, *jugaad* is used euphemistically to talk about the way in which corrupt means are used, particularly by non-elites, to navigate dense systems of bureaucracy and power. In her article *Provisional agency in India: Jugaad and legitimation of corruption*, Beatrice Jauregui explores the ways in which *jugaad* could be termed as provisional agency, describing it as follows:

> "The idiom of jugaad as provisional agency itself is the game changer, shifting the morally charged margins distinguishing the powerful from the powerless, those who have (more) from those who have not (or have less), and the takers from the givers of material resources or future favors."
>
> (Jauregui, 2014, p. 82).

She suggests that, using conceptualisations of power as argued by Eric Wolf (1990), the role of *jugaad* could be termed as "answering 'structural power' with 'tactical power'" (Jauregui, 2014, p. 84). This framing of *jugaad* in addressing power relations and forms of resistance is presented with reference to relationships with police and state authority. I argue it also has a key role to play in understanding structural power, and the reactions it provokes, within this technological system. *Jogad* could potentially refer to this process of users redesigning,

remoulded and de-scripting the uses of the technical object, widened beyond objects to institutional relations as well as ideas, values and behaviours valued by others as to how people should live or use energy. This incorporates theoretical linkages extending beyond physical objects, to alternative types of innovation, 'development' and modernity.

However, within the analysis of *jugaad* or disassembly with relation to the micro-grid, there needs to be an acknowledgement of how social structures act to shape these processes and potentially act as a limitation on the agency people have to do this. This engages with social politics of the context itself, as well as role of structure within considerations of the social construction of technology (Klein & Kleinman, 2002). Jauregui's conceptualisation of *jugaad* engages with ideas of resistance and an appropriated power, placed within wider political structures. However, as will be explored within this thesis, the ability of people to appropriate power from the micro-grid were also very much bounded by the politics of the community itself. This most prominently links to intra-community gender and caste dynamics, but also to the role of the state and forest, in differential abilities for people to deconstruct and re-scribe the meanings, values and purposes within the micro-grid. These abilities ranged from the group of higher caste men who were able to negotiate directly with the engineers of the system to leverage changes in the structures around it, to more marginalised groups using more subversive means to undermine the system, to women in the community dismantling the ideas embodied in the system primarily through critiques and discursively reimagining the system. These are primarily explored in chapter 4.

The framing of the micro-grid as an assemblage presents the opportunity to engage with the dismantling not only of the material system, or even of the structures and relationships which facilitated it, but also the ideologies and imaginaries that were carried within it. These had, in effect, been 'scripted' or 'coded' into the system by its engineers and by wider narratives in the micro-grid sector and were particularly shaped by gender relations. This incorporates ideas of what sustainable rural futures might looks like, often encapsulated in development buzzwords (Cornwall, 2007), the most prolific of which was the 'smart' future the micro-grid proposed. In this thesis (particularly in chapter 7) the 'buzz' around the system and the potential futures it proposes is conceptualised as a form of 'charismatic' technology (Mazzarella, 2010; Ames, 2015), derived from Weberian concepts of charismatic authority (Weber, 1947). The charisma attached to the people, technologies and futures encapsulated within the micro-grid assemblage are seen to mobilise the micro-grid project within external

audiences, particularly those engaged with the global narratives surrounding off-grid energy. However, as chapter 7 argues, this charisma is far from universal, and becomes one of the key points of contention in how the micro-grid is experienced and perceived by local users. Much of the dismantling and appropriation of the micro-grid assemblage that I interrogate within this thesis relates to the deconstruction of the ideologies, imaginaries and charisma of the micro-gird. Ultimately, the contentions within the deconstructions illuminate fundamental contradictions in what the micro-grid means and represents to the communities surrounding it.

1.7 Case Study and Thesis Structure

This thesis focuses on the state of Odisha as the context for investigation, primarily centring on the Urjapur micro-grid within the wider state off-grid energy ecosystem. This was an important distinction in providing an analysis that grounds itself within the nuances of the localised context. It was tempting at points during fieldwork and analysis to expand the scope to refer to wider micro-grid developments in other parts of India and South Asia, as Odisha only represents a small component of the wider micro-grid ecosystem. However, as a state of over 45 million people, Odisha alone has vast social, economic and cultural diversity which necessitates situated and contextualised analysis. This thesis draws on literature from micro-grids and off-grid energy in the wider South Asia and Global South contexts and, where relevant or mentioned in interviews, refers to projects in other parts of India. It does not, however, attempt to provide a comprehensive overview of micro-grid developments across India.

The main case study for this thesis is the Urjapur micro-grid. I spent one year of fieldwork in Odisha, where I supplemented the time spent in the village with a one-month period spent at the control room of the system, with interviews with key government, NGO and private sector actors involved in the micro-grid and with a small number of short visits to other micro-grid sites across the state. After my fieldwork, I spent several months in Delhi in the research and policy space, which ultimately formed an extension of my fieldwork.

I primarily used ethnographic methods to conduct this fieldwork, utilising a combination of unstructured interviews, participant observation and informal discussion groups. This methodological approach to the research was central to building a grounded, situated and in-depth account of the politics surrounding the micro-grid assemblage and to fulfilling the research aims of this project. More detail of these methods, along with reflexivity on my own

positionality and subjectivities, are explored in chapter 2. This chapter also introduces the main case site for this thesis, Urjapur. It provides an introduction to some of the key people in the village who feature through this thesis, and gives background and context to the community which are useful for understanding the micro-grid *in situ*.

Chapter 3 explores the development landscape of the community. It explores a range of development interventions in the village preceding and concurrent to the micro-grid project, through conversations and observations from my fieldwork. These interventions include government schemes for healthcare, housing, sanitation and agriculture, a forest office implemented project for ecotourism in the village, self-help groups established by NGOs working in the community and energy access projects implemented by government agencies and NGOs working in the community. The chapter interrogates how the community responded to these interventions and how different groups in the community worked to appropriate and remould these projects to suit their own needs. This chapter argues that the practices of *jogad* were central to how people adapted projects to meet the challenges they faced, particularly where the intended outcomes of the projects and schemes provision were inadequate or irrelevant to the needs and wants of the community.

Chapter 4 builds on the arguments of chapter 3 to explore the politics around the SolarFuture micro-grid. It focuses on the varied reactions and responses to the micro-grid's implementation, exploring the ways in which the community deconstructed the system, in their comparisons between it and the main grid, in their aspirations of how they would have liked to use energy from it and in how they drew alternative and unexpected opportunities from it. This is contrasted to the 'script' with which the system was designed and explores the dissonances between the designers and the different groups of users. It argues that the ways in which the system was critiqued, appropriated and subverted worked to continuously dismantle and deconstruct the micro-grid assemblage, undermining the developmental logics of its inception. This served to reframe the micro-grid as an arena of contestation and negotiation between different actors.

Chapter 5 looks at the relationship between the micro-grid and the forest. It explores how the political ecologies of the region intersected with the narratives around solar energy in the area and with the micro-grid itself. Through ethnographic vignettes of interactions between the community and the forest office, it deconstructs the contradictory logics around 'sustainability' and how they were mobilised within both the forest management and

conservation efforts and in the micro-grid project. It argues that the forest took on multiple roles in how it was perceived in the community, and was a vehicle for how the community experienced state intervention, but that in and of itself, the forest and politics around it were also engaged in the processes of 'pulling apart' the micro-grid assemblage. It argues that the geographies, environments and ecologies surrounding micro-grid projects extend from being enabling or disabling contextual features to being key actors within the assemblage.

Chapter 6 expands the exploration of the wider ecosystem for micro-grids across the state. It aims to provide context for the Urjapur micro-grid within the landscape of projects in Odisha, but also explores the conflicting ideologies and politics embedded within micro-grids by the range of actors developing them across the state. These include government agencies, NGOs and businesses, all of whom had definable aims, objectives and aspirations for what the projects could achieve and what they should look like. This chapter is based on interviews with actors working on installing micro-grids and on visits to other micro-grid sites in Odisha. It focuses particularly on what was, effectively, the failure of numerous micro-grid projects to realise the expectations of their implementors and the ultimate 'deaths' of many of these projects. It seeks to understand why and how these projects died, and how this reflects on the politics of the technology itself.

Chapter 7 presents more of the 'back end' ethnography of how the Urjapur project was conceived and designed, particularly using data from a short period of time spent at the university campus in coastal Odisha where much of the development, design and control of the micro-grid took place. It asks the question of how, despite all the processes of disassembly, critique and dismantling, the visions of the 'smart' micro-grid persevered. It utilises ideas around charisma as a means of understanding what it was that continued to adhere and mobilise the 'smart' micro-grid assemblage through the charismatic people, technologies and futures associated with it. It draws this as a counterpoint to localised disillusionment, alternative versions of localised charisma and deconstructions of the failures of 'smart' interventions in the community. It argues for a reconceptualisation of how the 'smart' futures proposed by the grid were constituted and how they serve to obscure the politics associated with them.

Chapter 8 explores the interconnected dynamics between Urjapur, the university campus and policy and research spaces in Delhi. It draws on conversations I had with young women across these three sites, as well as observations of workshops specifically focusing on gender

and energy. It looks particularly through the lens of gender at how power structures and gender relations shaped and re-shaped the micro-grid assemblage, within the off-grid energy space. It looks at the role of gender in the places and spaces of technological innovation as well as in the spaces informing renewable energy policy and project design. It argues that patriarchal structures play a role across this system, but also serves to shape our understandings of what energy is and how energy is used.

The conclusion to this thesis provides a summary of the arguments made throughout and a brief summary of some potential policy and practice recommendations that may come as a result of this study. The conclusion also includes an epilogue, which reflects on some of the events and developments in Urjapur since my fieldwork ended. This includes the reintroduction of tigers into the reserve in late 2018 and the electrification of the village in the run up to the 2019 elections. It presents closing questions about how these reflect on the nature of the Urjapur 'smart' micro-grid project.

2. Methods and Introduction to Urjapur

2.1 Introduction

This chapter is split into two sections. Firstly, it provides an overview of my methodological approaches, alongside their interaction with my own positionality and subjectivities. Additional detail relating to my methods is provided at relevant points in the rest of the thesis, particularly when referring to smaller periods of time spent outside Urjapur (for instance, field visits to other micro-grid sites and time spent at the university campus where the system was designed). Likewise, reflexivity about my own role, positionality and subjectivities in the field is introduced here, but I provide more detailed reflection on specific situations, events and conversations as it is relevant in other chapters, particularly in reference to specific ethnographic vignettes and quotes.

Secondly, this chapter introduces my main field site, Urjapur. This introduction provides a background to the community, including both understandings of the historical context, as narrated to me by older members of the community, as well as conversations with younger members about their aspirations and future goals. This serves both to introduce the community, and to provide context within which the analysis within this thesis fits. Alongside that, this section profiles some of my key interlocuters from Urjapur, who informed my understandings of the community and who feature throughout this thesis.

2.2 Methodology

The aims of this thesis have been to provide an in-depth, grounded and situated understanding of the experiences, politics and relationships surrounding micro-grid systems. However, the way in which this has been achieved has changed and adapted over the course of the project. It has aimed to centre the analysis primarily on the experience of those using the system, paying particular attention to the gender and caste relationships involved in it. I have been keen to use methods which enabled me to engage meaningfully with the experiences of those often left out of wider narratives around renewable energy.

My fieldwork took place from early 2017 to mid-2018. I was primarily based in Urjapur, the village where the SolarFuture micro-grid was implemented, with additional supplementary visits and interviews in other parts of Odisha and in Delhi. The fieldwork period presented

what felt like innumerable challenges of various types. While research decisions made during this period were primarily guided by my research goals and approaches, they were also constrained by practical feasibility and attempts to navigate the numerous hurdles which presented themselves. Many of these are part and parcel of working in the context of Odisha and required ongoing flexibility within my research methods and decision-making, both to meet my research objectives and to maintain appropriate ethical standards and integrity. Fieldwork was a learning process. With hindsight I may have made some different decisions at points throughout the fieldwork period but the fieldwork itself was part of the process of reaching such perspectives. Importantly, my fieldwork not only enabled me to meet my research aims but also helped me to understand how those research aims might be developed in more informative directions.

The first month of my fieldwork was mostly spent based in Bhubaneswar, where I orientated myself within the wider off-grid energy sector in the state and built a network of contacts. This involved undertaking preliminary unstructured interviews with government officials in departments relating to renewable energy, forestry and grid extension, technical contractors implementing off-grid projects and NGO practitioners working on similar projects across the state. This was largely done through a process of 'snowball' sampling (Atkinson & Flint, 2001) starting with connections made through former colleagues from work in South India and friends of friends based in Odisha. I had planned this period in order to seek out connections and networks which might be useful for accessing potential field sites. The time in Bhubaneswar, however, also enabled me to situate my detailed analysis of the Urjapur micro-grid within the state-wide off-grid energy landscape. This features particularly in chapter 6.

I had initially envisaged tracing a micro-grid project through its processes of implementation, using observational data from meetings between the engineers and the community as a means to understand the processes of inclusion and exclusion associated with the project. These plans changed early on as it became clear from speaking to people in Bhubaneswar that, while there were numerous micro-grid projects being planned in Odisha, there were few, if any, actually coming to fruition, particularly during my time-limited fieldwork period.

The decision to use the Urjapur micro-grid as the main case study was fairly straightforward. I had already met with Anshuman, the head of the company who had implemented the project, while I was in India undertaking language training in the summer of 2016, and so was familiar with the project. It presented numerous interesting research opportunities, such as

the inclusion of ‘smart’ technology and the opportunity to have access to the engineers of the systems as well as the community, and was logistically feasible.

Prior to starting work in Urjapur, I spent one month at the university campus in coastal Odisha where much of the system had been designed and where the ‘back-end’ control systems for the ‘smart’ component of the micro-grid was situated. Here I undertook a short ‘control room’ ethnography (Silvast & Virtanen, 2014). This allowed me to understand the technical components of the micro-grid system and to understand the view of the micro-grid from the perspectives of those designing and controlling it. This was aided by my background in renewable energy engineering which gave me the technical literacy to understand the nuance in the technical design. However, potentially more importantly, identifying myself as an engineer gave me a ‘stamp of approval’ which opened up doors with regards to how I was received by other engineers and the data I had access to. The data from this period forms significant parts of chapters 6 and 7.

After leaving the university campus, I started fieldwork in Urjapur. The initial period I spent there was through the summer from March to July. Despite the harsh weather, with temperatures regularly hitting upwards of 50°C, this turned out to be a good time to be in the village. There was less farming work done then, so most people had more time available and were happy to talk. During monsoon season, the road to the village flooded and access in and out of the community became difficult. At this point, I made a return trip to Edinburgh, undertook more interviews in Bhubaneswar and made field visits to other parts of the state. I returned to Urjapur from September to December, alongside intermittent visits to other micro-grid sites elsewhere in the state. I left Odisha in December but returned to India a month later to undertake a three month placement in Delhi working with policy think tanks and research organisations to develop a network around gender and energy. This effectively became an extension of my fieldwork, and features in chapter 8.

I used ethnographic methods as the primary tool for data collection, which primarily consisted of unstructured interviews, observation, participant observation and informal group discussions (Atkinson & Hammersley, 1994; Bernard, 2017). I chose these methods after a significant period considering alternative options, which included combining elements of participatory research methods (Chambers, 1994) and social network analysis (Scott, 1988; Wasserman & Faust, 1994). These were centred around the aims of the project to understand the relational aspects of the social structures around micro-grids. Ultimately, however,

ethnographic methods served the aims and commitments of this research best and had specific practical benefits. Within a context that was often unpredictable and required significant flexibility on my part, ethnographic methods were much more adaptable, but they also enabled me to ground my analysis within the range of conceptualisations of the micro-grid that were apparent in Urjapur. This helped me to understand what the micro-grid meant from a multitude of perspectives and was central to positioning the research with the community of the 'end-users' of the system.

Ethnographic methods were also helpful in limiting the imposition of my own normative expectations of what 'energy access' should look like within the research design. This allowed me to engage with the full complexity of the micro-grid system, situated within its specific context, providing more nuance and detail than might otherwise have been possible. Throughout the fieldwork period, it became increasingly important to me to acknowledge that while the micro-grid was central to my analysis, it was situated in a complex, dynamic and multi-faceted context, where often the micro-grid was (understandably) often not a focus of everyday life.

While the fieldwork primarily centred on the Urjapur micro-grid, engagement across multiple locations helped to produce a multi-sited ethnography (Marcus, 1995). The multi-sited nature of the fieldwork was important in providing an in-depth exploration of Urjapur not only as an isolated village community, but as a community sitting within complex and interconnected social and political structures stretching across the state, country and globe (Gupta et al., 1997). This is particularly reflected in the analysis presented in the latter chapters of this thesis. Across these sites, usage of different combinations of ethnographic methodologies (unstructured interviews, discussion groups, observation and participant observation) contributed to forming a nuance understanding of different perspectives and relationships.

In Urjapur, I primarily depended on observation of community meetings, interviewing members and participating in informal group discussions as the means of collecting data. These allowed me to observe interactions between people in the community and between the community and state actors, but also to gain in depth understanding of the multitude of perspectives and opinions of people across the community. Informal group discussions were particularly helpful in disentangling how groups in the community interacted with each other and in understanding contentious issues. While in Urjapur, there were limitations on the

extent to which I could fully immerse myself directly in participating in community life (see discussion on access below). I was able to participate in certain activities, such as cooking or processing food collected in the forest, and these helped me to develop a tacit understanding of day-to-day life in the community. However, this understanding was rarely directly related to the focuses of my investigation, and thus features less in the ethnographic vignettes used in this thesis. Outside of the community, however, while living and travelling in Odisha as well as working within policy organisations in Delhi, my own participation in daily life, work environments and in navigating interactions with the state, among others, was more central both in gaining access and developing understanding of the social structures at play. This is demonstrated below in the section looking at access to my field site, where I detail how my engagement in trying to gain permission to work in the forest provided me with an understanding of the workings of the forest office. Ultimately, across the course of my fieldwork, it was adaptability and the use of various types of ethnographic methods which enabled me to take full advantage of opportunities to collect different types of data.

2.2.1 Research Assistance

While working in Urjapur, I hired a local research assistant, Subhra. She is of critical importance for my entire thesis (Middleton & Cons, 2014), in helping to build relationships within the community, acting as an interpreter, in helping me to make sense of the events and conversations in the field, and as a friend and confidant. Initially her primary role was as an interpreter, but ultimately she became central to shaping my understanding of the field.

I had always intended to hire a woman as a research assistant, based on experience working in rural South India prior to my PhD. When working with only male colleagues, I was aware that the conversations we had were almost exclusively with men, particularly those who were in positions of power, owned land and were usually higher caste. I hoped that having a woman as a research assistant would enable closer relationships and more open conversations with women and people from more marginalised groups within the community, which it did to an extent I could not have anticipated.

Finding a woman to be a research assistant, however, was challenging. While I had contacts in universities in Delhi and Mumbai, there was no one who spoke Odia who was immediately available. Instead, most spoke Hindi and so would have needed a local translator anyway and who, while Indian, would also have been to a great extent an ‘outsider’ (Merriam, et al., 2001). Prior to fieldwork, I had undertaken two months of formal language training in Hindi.

I had prioritised learning Hindi over Odia because of the greater ease in accessing language resources and its wider and more flexible uses when travelling. The language diversity across Odisha meant that I did not know whether my future field site would be an Odia speaking community or one of the many other Adivasi languages spoken in the state (Nathan & Xaxa, 2012; Sengupta, 2015). In Urjapur, people primarily spoke Odia, though men spoke Hindi and some Adivasi languages were also spoken. I picked up more Odia (at least to the point of being able to understand conversations, if not to be able to fluently converse) over the period of fieldwork, but a local translator was critically important in helping my understanding of wider contexts, nuances and specifics of conversation.

I opted to find someone as local as possible, aware that this might limit the training and experience level that would be available, but also keen to find someone who had familiarity with the villages in the area. Even in Bhubaneswar and Angul (the town closest to the Urjapur), however, finding someone proved difficult. I worked through word of mouth, asking friends of friends if they knew anyone and met numerous young women who were interested in the project, but whose families objected to the idea of them travelling to and staying in a village for periods of time.

While frustrating, this gave me important insight into the preconceptions held in towns and cities about the communities living in the forested region, designated as a tiger reserve, where the village was situated. I was told of the safety concerns in travelling to the village unaccompanied by a man and about the rumoured (and exaggerated) presence of Maoist Naxalites. Elephant encounters and potential poacher attacks were mentioned, alongside the perceived 'immorality' of Adivasi communities in the area, which resonated with the 'othering' narratives of Adivasis (Shah, 2010).

I had almost given up and decided to have a male research assistant when Subhra contacted me. She attended the same gym as the owner of the guesthouse where I was staying in Angul and was keen to work with me. Her educational background was in electrical engineering and she had worked for a number of years in human resources for companies in Bangalore, before returning to Odisha. She had been born and brought up in Angul and was from a well-established, higher caste family and her maternal grandfather had been the Member of the Legislative Assembly (MLA) for the district. Her father, a recently retired government scientist, had grown up in a village not far from Angul, which had been relocated as the many steel works, coal mining and power plants industries had expanded.

Subhra had grown up living in towns but, as a result of the background of her grandfather and father, she was familiar with the villages in the area and was excited by the opportunity to spend time and learn about life in Urjapur. Luckily, her parents were also supportive of her working for me. Subhra had no experience as a research assistant or training in social sciences. She was enthusiastic and keen to learn as well as being genuinely interested in my research. Working together to establish expectations and a good working relationship ultimately provided constructive opportunities to talk more reflexively through my own approaches and to establish a collaborative exchange on how we were understanding the events and conversations throughout the fieldwork period (England, 1994). There is a need for reflexivity in the role Subhra played as an interpreter in my research (Leck, 2014), including in the cultural meanings of how translations were made and what assumptions, values and perspectives were embodied within them (Temple & Edwards, 2002); this fits within the wider role that she played in helping to build relationships in the community.

Her upbringing in a more urban area meant she had some preconceptions about the communities in the area, which I was initially concerned might impact how we interacted with them and how she would interpret what people were saying. However, she was largely open minded and often commented on how her own perspectives were changing as we learnt about the lives of people living there, which was something we frequently discussed. Some of the men in Urjapur, particularly those involved in local politics, had known Subhra's grandfather. During his time in office, he had worked in the area and members of the community credited him specifically with ensuring they had formal land rights. Households across Urjapur had a higher level of formal land ownership that other villages in the area, which was said to be critical in leveraging their rights with respect to the forest office. He seemed to be respected by those who had interacted with him and so, by extension, was Subhra (and I). This relationship could have impacted the power dynamic between Subhra and the community but, by and large, it seemed to act more as an assurance that we were 'on their side'. Given the frequency with which people would vent to us about their frustrations with the government, they were presumably not particularly intimidated by us nor concerned about the repercussions of talking to us. Particularly when talking to women in the community, Subhra's local accent and familiarity with the area seemed to provide a bridge of sorts for my own 'outsider' status (Liamputtong, 2010).

2.2.2 Access

The community in Urjapur were broadly welcoming to me and Subhra. However, negotiating access to work in the village was not without challenges. Its location inside the tiger reserve put it under the jurisdiction of the Indian Forest Service, a branch of the Indian Civil Service responsible for the management and conservation of India's forests (Hannam, 1999). Their presence underpinned nearly every aspect of the lives of people living there (much of which is explored in more detail in chapter 5), but also meant I required their permission to conduct research there. I was initially told this could take up to two years and would need the support of the state forest office in Bhubaneswar. However, the district forest office in Angul decided this only applied to those wishing to research the ecology of the area. This was an early indication of the forest office's priorities, where the people living in the reserve seemed largely incidental to the wider 'conservation' mission. However, even when this permission was granted, the local police, who had a presence in the reserve, raised persistent concerns about my travel there.

In large part, this concern seemed to stem particularly from me being a young, white, foreign woman. There were said to be low levels of Maoist activity in the area, as Naxalite groups used the forest as a thoroughfare for travel from region to region (Shah, 2019). There was a perceived higher risk to me as the Naxalites kidnapped two Italians in 2012 in Western Odisha (Times of India, 2012), though their activity and the subsequent state responses have overwhelmingly affected local communities (Borooah, 2008). Urjapur itself was not in a region with high Naxalite activity, but the police remained concerned about my safety. Likewise, the police were concerned about the risk of elephant attacks, which do kill a significant number of people in the area, and about potential run-ins with poachers.

Notably, there was far more concern for my safety and well-being than there seemed to be for anyone who lived there. I had drawn up formal risk management plans as part of fieldwork preparation, which had been agreed with the University of Edinburgh and, having made preliminary visits to the village, I was confident that any risks to my personal safety in the village were manageable within this (frequent outbreaks of malaria seemed the more pressing concern). While at points this concern felt uncomfortable and possibly somewhat paternalistic, I had no wish to alienate myself from the police and was broadly grateful to them for looking out for me. I was also aware that the police and forest officers may have

been concerned that if something happened to me in the reserve, it would cause a significant level of unwanted attention on their own departments, something they were keen to avoid.

Ultimately, we came the agreement that I could work in Urjapur provided I did not stay there overnight, I did not travel alone, my phone number and that of my research assistant was given to the police superintendent to warn of any Naxal activity, and that I did not travel around the reserve after 5pm, the time when the elephants became most active. It was a bizarre set of conditions, but I got the impression that there was little room to manoeuvre and they could just as easily deny me access to the field entirely. These conditions effectively shaped much of how I conducted my fieldwork. When things were more relaxed, Subhra and I would stay in the village, taking one of the rooms in the ecolodge run by the forest office (it was questionable why, if the village was so dangerous, they would rent out accommodation to tourists, even if they were not anticipating foreign tourists). However, this was not always possible, when the police or Subhra's parents raised concerns.

At these points, we would stay in Angul, and commute to Urjapur daily by autorickshaw. There were obvious disadvantages to this, as a lot happened in the community after dark, including much of the domestic usage of the micro-grid. Some community meetings took place in the evenings, along with interactions with the wildlife in the forest, state officials and the occasional Naxalites (which I was not entirely disappointed to miss out on). On balance, however, maintaining a good relationship with the forest authorities, the police and Subhra's family seemed more important, since any of these could have jeopardised my access completely. This was compensated for by the amusing rundown sessions we were given each morning by the women we were close to in the village, who were keen to catch us up on anything that had happened the previous night. While these second-hand accounts had disadvantages, hearing things from the perspective of those in community was valuable in understanding their outlook. Given that my interest in the micro-grid was particularly in how it was perceived by those using it, this also forced me to shape my understanding through engaging with the politics around it.

2.2.3 Ethics

As with any research project, there were important ethical considerations throughout. Where these considerations arose within specific fieldwork contexts, I indicate them within the text in other chapters; however, there were some overarching issues. In line with university ethics guidelines, I gained verbal consent from all participants and was explicit with

everyone in Urjapur, and at the other sites I visited, about the aims of my research. There is a question here about the limitations of 'informed' consent, particularly in cross-cultural contexts (Marshall & Batten, 2003), but I made every effort to be as transparent as possible. Pseudonyms are used throughout this thesis, with critical identifiers redacted where necessary.

There were also cultural sensitivities in how I went about recording data (Bernard, 2017, pp. 291-306). In interviews with NGOs or government officials, it was expected that I would take detailed notes throughout, but in Urjapur and other villages, I had to be more flexible and adaptive. Some people were happy for me to take notes, particularly, for instance, the older men who seemed to enjoy regaling me with stories about the history of the village. During events and meetings, I could also sit at the back with Subhra and take notes without disturbing the proceedings. However, many people in the community were clearly more cautious and I had to adapt to both make sure they were comfortable and to make sure I was fully engaged in the conversation. I was aware taking notes constantly throughout could come across somewhat insensitively. In these cases, we paused between conversations or visiting different households to stop and note down key points and important quotes, checking with Subhra for any details I may have missed. In the summer afternoons, most people would retire to their houses during the hottest parts of the day, which gave me the opportunity to catch up on more detailed note taking and observation, which I then wrote up electronically each evening, or at the end of a few days, if we were staying in the village.

There were definite drawbacks in this approach. Recordings of the conversations with the community would have provided me with more detailed information which would be easier to check later for details I may have missed in notetaking. However, recording interviews and conversations would have resulted in the need for transcribing and translating from Odia, which would have been logistically challenging, and it felt uncomfortable to ask this of my participants. There were a couple of instances where visitors to the micro-grid attempted to undertake video and recorded interviews with people in the community. This was generally very poorly received and clearly made people feel uncomfortable; something which I was keen to avoid. Quotes used throughout this thesis are primarily based on Subhra's translations, or, where she was not present, on my own notes.

It took time to build relationships in the community. By and large, people were welcoming and friendly, but there was definitely an understandable level of caution in how people

related to me and to Subhra. Some people were keen to talk to us, while others were more reticent, and we were guided in who we spoke to and spent time with largely by who was interested in talking. Eventually we fell into more of a routine; people in Urjapur seemed to get more used to having us around and, while I was always blatantly a foreign outsider, things became more relaxed. In conversation, in particular, it seemed that me being foreign opened up a lot of conversation topics. I think it helped that both Subhra and I were young and unmarried and were potentially seen as less intimidating because of that. By comparison, when Anshuman and other more senior male visitors from SolarFuture visited the village, there was considerably more formality, though the younger SolarFuture engineers also seemed to have a good rapport with the men in the village.

I was careful about managing was my relationship with SolarFuture, the company implementing the micro-grid. From the beginning of the project, I did not want to be based within another organisation, be that SolarFuture or a local NGO or institution. This created challenges. An affiliation with a local NGO or with an implementing organisation would have had logistical advantages, particularly when travelling, finding places to stay and hiring research assistants, and might also have given me easier access to respondents. However, from personal experience in the Indian development sector, I wanted to ensure I would be in a position to undertake independent research, without the biases of an organisation influencing the questions I could ask, the people I could talk to and the conclusion I might draw. I was also keen to avoid any politics which might arise between or within any organisations. Because of this, I organised the logistics of travelling to and staying in and around Urjapur through friends and more informal contacts. This provided practical challenges, but ultimately ensured that I did not feel compromised in the relationships I could build and the data I could access.

That said, being on good terms with SolarFuture was important and provided me with valuable insights. Being able to interview the engineers involved in the project provided me with an understanding of the system from their perspective and the time I spent at their control room in Berhampur was invaluable. For the most part, however, my interaction with SolarFuture was fairly *ad hoc* and informal. The head of the organisation, Anshuman, would visit Bhubaneswar every few months, and I would meet him there if our schedules coincided. I would also see SolarFuture representatives if they were visiting Urjapur while I was there. Upon Anshuman's request, I signed a two year non-disclosure agreement prior to spending

time the Berhampur and in Urjapur. This covered only the technical components of the system, which were never a focus of my thesis. I was hesitant at first, but, ultimately, I understood why he might be concerned about my motives in being there and signing it made no real difference to my project or the conversations I was having in Urjapur.

It was in Urjapur itself that I was most concerned about how my relationship with SolarFuture might be perceived. I was concerned that if I were seen to be part of SolarFuture, I would have difficulty building in relationships and that people might tell me information and opinions based on what they thought I wanted to hear. Equally, I was cautious of becoming a go-between within the numerous disputes between SolarFuture and the community (many of which are outlined in chapter 4). As a result, while I was never disingenuous about knowing and being on good terms with SolarFuture, I maintained a distance from them that I felt was critical in establishing trust and ensuring that people could rely on my own assurances of confidentiality and anonymity. Subhra and I spent the vast majority of our time in Urjapur without SolarFuture present and we used other contacts to provide us with an introduction to key people in the village when we first arrived. At first, regardless of my efforts, it seemed that people were cautious in sharing their opinions on the micro-grid but, over time and as we built better relationships in the community, people became more vocal and more critical about the system.

There were some topics, however, which were clearly off-limits. These largely related to the community and the police and forest office rather than SolarFuture. While many people, particularly higher caste men, took every opportunity to vent their frustration with the government, certain more illicit activities were taboo. In particular, discussion about hunting and poaching was unwelcome, and usually provoked adamant denial that anyone in the community partook in them. Given that a forest officer was permanently based in the community to ensure no one was hunting or poaching, I could understand why people would be cautious about talking about it. Most people seemed to be on good terms with him and he was friendly to me and Subhra, but there was still an overall environment of surveillance with relation to the forest that I did not want to add to.

Equally, any mention of Naxalite activity was usually met with hushed tones. I rarely asked about these topics, not wishing to push any sensitive questions and not seeing their immediate relation to my research. However, once I had been in the village for longer, the women we spent most time with did occasionally mention them. I still maintained a level of

caution in talking about this; I never asked follow-up questions and I would only ask for necessary clarification from Subhra once we had left the tiger reserve. In line with generally accepted research ethics practices (Brooks, 2014), I never passed this information on to anyone and no incriminating details that could cause harm to the community are included within this thesis.

Alongside this, women in Urjapur frequently spoke to Subhra and I about sensitive and difficult topics, often particularly pertaining to domestic abuse and sexual violence. We did not ask about these topics, but they frequently came up. For the most part, specific details and direct quotes from these conversations are not relayed within this thesis since, while my respondents gave me verbal consent to be interviewed, I do not want to share personal and sensitive information. However, the insights from these conversations were important in forming my understanding of the gender relations in the community, which are central to this thesis. The intersection between the wider gender structures and relationships in the community and the micro-grid project itself are explored in detail in chapter 8.

Subhra and I often spoke about the more difficult conversations we had in the community between us. I was aware that I was unequipped and unsupported to deal with such topics and concerned that she may well have felt the same. Realistically, she probably provided more support for me, particularly given she was nearly 10 years older and had more experience in dealing with such issues, as well as her own support system nearby. We both felt that there never seemed to be an expectation that we would be able to provide help in any of these situations and no help was directly asked of us. However, the emotional component of this was a challenging aspect of the research process (as discussed in Warden, 2013) and this intersected with my concerns about the ethics of the close relationships we had built with women in the village. I had no wish to surface difficult topics for my participants, build emotional dependencies or 'abandon' them once my fieldwork period was over (Stacey, 1988). However, the line between giving participants the space to speak about what they wanted to and implementing my own personal boundaries on what was 'safe' to talk about was difficult to tread and often challenging to judge in the moment (Watts, 2008). Equally, when analysing data and writing this thesis, there were some conversations, events and observations which felt important to me, in terms of how I understood and related to the people in the community, but which had little direct relevance to the micro-grid project. For me, this has led to a fairly constant awareness, and sometimes anxiety, over how I

represent my participants in my writing and how I do justice to their opinions, experiences and perspectives. This was particularly pertinent in not wishing to perpetuate colonial representations of 'passive victims' in this context (Said, 1985; Mohanty, 1988).

2.2.4 Positionality & Reflexivity

My own positionality greatly impacted my research design, data collection, data analysis and the overall conclusions drawn for this thesis. My intersecting identities as a young, white, unmarried woman coming from a formerly colonising power, all impacted both how I was perceived in my fieldwork and how I navigated and interpreted the relationships, conversations and observations during this period. Equally, my disciplinary background, coming from engineering before moving into social sciences and coming from institutions in the Global North, also shapes the understandings I draw from my data as well as my positionality in the field. These factors also shape the opportunities afforded to me through my background as well as the potential future opportunities I might have. I feel this is particularly important in how I represent my participants within the writing and the perspectives that I present. I try to reflect on the implications of my positionality and subjectivities throughout the thesis, but outline some of the overarching issues here. My own subjectivities inevitably shaped the research and my interpretation of the data, but this was also a dynamic and evolving process. As much as my fieldwork shaped my data, it also challenged and changed my own outlooks and perspectives on wider level, a factor that was particularly relevant during the writing process.

The implications of my identities had varying implications on fieldwork. These varied in different locations and when interacting with different people across fieldwork. There were inherent power dynamics from my positionality as a white, relatively wealthy and privileged woman from a former colonising power in the Global North. Many of the ethical dilemmas embodied within this research and within my role in representing people, and particularly women, with whom there was a fundamental power differential (Wolf, 2018) have been the source of considerable reflection on my own part, from which I do not have particularly satisfying conclusions, but have tried to remain cognisant of throughout my research and writing.

Having since had numerous conversations with South Asian peers (particularly women) who have undertaken similar fieldwork, there are clear differences in how I was received in the communities of my fieldwork, but also in what I could and could not 'see' in these contexts.

The structures and relationships around caste, for instance, were typical of this. Having not grown up within the caste system and not having a caste identity myself, there were limitations on my understanding of the lived experience of it. I depended significantly on the interpretations of Subhra and of my respondents to understand the role of this and, thus, may well have missed out on understanding aspects which they did not see as relevant or did not want to share. Equally, in spaces outside of Urjapur, where I was working without Subhra and where caste was less immediately apparent (to me) than in the village context, I was dependent on my own, much more superficial, understanding of such structures and relationships.

However, my 'outsider' status, without a perceived caste identity, nor an association with coming from urban India, or specifically Delhi, also enabled me to talk more easily across different caste and tribal groups within village communities than might otherwise have been possible. This is not to diminish the impact of power relations between me, as a comparatively wealthy foreigner, from a former colonial power, and the community, which played a role and was something I tried to be cognizant of. However, conversations with South Asian peers researching in rural South and North East-India, as well as observations from Subhra, indicated that I may have had an easier time establishing relationships with some groups specifically because I did not fit in with established caste hierarchies, but this may also have caused me to overlook certain nuances in my interpretation of events and conversations.

In the same vein, being a white woman also gave me a specific, but also varied and multifaceted positionality in the field (Caretta & Jokinen, 2017). By and large, particularly accompanied by Subhra, I was able to form close relationships with women in Urjapur much more quickly than I had anticipated. I spent more time with women and they were fundamental to forming my understanding and perspectives of the village. Younger women from across the community in particular seemed to be more enthusiastic in seeking out opportunities to speak to us. Older women and some Adivasi women were often more cautious and took more time to open up wider conversation. By contrast, conversations with men tended to have more formal dynamics and rarely touched on the more emotional and personal topics that frequently arose when speaking to women. Men did not seem uncomfortable talking to us, but conversations revolved more directly around discussing the government, the micro-grid and forest and farming issues.

It was unclear if this was because of me, the questions I asked to different people, or reflective of different priorities and focuses from different groups in the village. However, some of these dynamics are reflected in this thesis, where often the more specific quotes about the government, for instance, usually came from higher caste men, while discursive observations stemmed from the time spent with different groups of women in the community. I try to indicate who and from what group in the village I refer to where possible, and draw out relevant correlations with how different groups seemed to engage with different issues.

Outside of Urjapur, however, there were entirely different dynamics and a different set of power relations to navigate. Here, my age, ethnicity and gender played a different role in how I interacted with government officials, NGO staff and SolarFuture engineers in Bhubaneswar and in the region around Urjapur. These spaces were overwhelmingly male dominated and were often distinctly hierarchical. However, from work experience prior to my PhD, I had a good understanding of how to navigate these spaces and what to expect from them. Being foreign and coming from an institution in the Global North meant that I was given a level of privilege in accessing meetings, but there often seemed to be an assumption that I had a very low level of knowledge and understanding about the context or the topic I was researching. By and large, though this was something I had to learn to be patient with, it was not a particular issue, as it meant that respondents spent extra time explaining details to me, from which point I could ask better informed and pertinent questions. Being able to have these conversations in English and in more of an interview format meant I was able to get a greater quantity of information in a shorter period of time. However, these interviews were often more transient and less in-depth; I learnt much less about the background and subjectivities of my respondents. There were challenges in interacting with government and NGO staff when I needed access to contacts, information or permission to access specific places and people because I was more beholden to their expectations and opinions on what I should be doing; the interactions with the police and forest office in accessing the tiger reserve was symptomatic of this and reflected the way in which I was perceived in the field.

Being an engineer in South Asia, where engineering as a profession carries a greater level of respect than in the UK, opened doors during the fieldwork period. By and large, it seemed of little importance within villages, where my identities as young, foreign and a woman had

more impact. However, when meeting government officials, other engineers and NGO staff, being able to say I was an engineer, even while being clear that I was not there in my role as an engineer, seemingly gave me the 'stamp of approval'. This meant there was little hesitation in providing me with technical details, which were often punctuated with the social details I found more interesting. It seemed that being an engineer allowed me to speak a language which gave me access to other types of information.

However, coming from a technical background also changed to how I related to my participants. While I had more familiarity with the mindsets and approaches of the engineers involved in the projects, I sometimes found myself being more critical of other engineers and their practices. In my own experience, transitioning from engineering to the social sciences had involved a process of unlearning and relearning my own training from a different disciplinary perspective, particularly through reading work such as Bruno Latour's *Science in Action* (Latour, 1987). My familiarity with engineering, and particularly with its epistemological underpinnings, potentially made it easier to judge more harshly. It was also tempting to overlook the other intersecting identities, influences and perspectives of the engineers involved in this project, as it was the identity and mindset of 'the engineer' with which I had most familiarity. This was something I tried to be aware of throughout my fieldwork.

In terms of how my positionality impacted how I interpreted data, there are also numerous considerations. Having grown up and lived primarily in the UK, I have been surrounded primarily by Eurocentric knowledge systems for most of my life (Alvares, 2011; Caretta & Jokinen, 2017). While I have lived in numerous different cultures and have engaged with movements to decolonise academia (Mohanty, 1988; Alvares, 2011; Lennon, 2017), I inevitably still embody numerous biases because of my background. Having worked prior to my PhD in the Indian 'social' sector (NGO/social enterprise/development agencies), I was familiar with the rural development landscape in India and indeed it was experience in this sector that shaped many of my understandings of the Indian context. However, within the development sector there are also normative assumptions and biases which were important to be aware of in collecting and interpreting data; potentially most pertinently in terms of what constitutes 'development' (Crewe & Harrison, 1998; Ferguson, 1994).

There were also more complex emotional components to my experience of fieldwork and how this shaped my data collection and analysis. This was pertinent within specific 'field sites'

but also apparent in interactions with the 'gatekeepers' required to gain access to the field, in the dependency on the wider 'scaffolding' (Wagner, 2018) of people and networks who helped to facilitate my fieldwork and in events which took place over the course of fieldwork. Alongside my experiences of privilege, there were also distinct vulnerabilities which were largely shaped by my gender and age. By and large, much of these components do not bear direct relevance to my research topic or analysis and are somewhat 'written out' of this thesis (Wagner, 2018). However, my personal experiences as a researcher and my emotional responses to these have had impacts on how I interpret components of my data and how I relate to my participants. Some of the gendered vulnerabilities of ethnographic fieldwork have been explored within disciplinary 'glorification' of solitude, danger and intimacy (Hanson & Richards, 2017) and in regards to risk within neoliberal institutional structures (Huang, 2016; Schneider, 2020), which resonate significantly with my fieldwork experiences.

While there were, inevitably, biases coming from my own background and upbringing, these were also coupled with the learning processes and the impact that my fieldwork had on me as a person beyond the data that I collected. This was an ongoing process of learning, reflecting and understanding which took place throughout my fieldwork and during the writing up period afterwards. This was informed by conversations with Subhra and my interlocuters and also with peers and with Indian friends, particularly women, who had worked in similar fields and with whom I spent considerable time talking through my experiences, data and understandings. This process was critical to reflecting on my own subjectivities and the impact of these on my analysis. A particular component of this was in how I represented my participants in my writing, in attempting to both honour the experiences and opinions they narrated to me in a way that was not exploitative and extractive. Indeed, it was in grappling with how to achieve this balance that understandings of the capacities and agency which are central to this thesis became most apparent.

Figure 4: View of Urjapur.

2.3 Urjapur

Urjapur took around one and half hours by autorickshaw to reach from Angul, the district headquarters. The journey to get there left behind the dust and pollution from Angul's numerous steel and aluminium works, as well as one of the largest coal fields in India, to travel through open paddy fields before reaching the forest and the tiger reserve within it. Subhra and I became very familiar with this journey, and it was characterised by the vast contrast between the town and the forest. The forest was stunningly beautiful (see figure 4) but hid considerable challenges for those living and working there. They faced environmental and climatic risks, political oppression and structural violence and lack of access to jobs, resources and basic facilities. When we travelled to the village, we would be stopped at the entrance to the reserve to pay the small fee to take the auto rickshaw in, after which we

drove to Urjapur. There were numerous villages inside the reserve, mostly situated along the roads, between which there were intermittent sections of forest.

Urjapur itself was fairly deep inside the forest, linked to its nearest neighbour, Simulia, by a *kutcha* (earth, untarmacked) road. It was defined as being in the 'core', protected forest area, but the village itself was comprised of multiple smaller *sahi* (hamlets) spread over a 2km area, surrounded by dense tropical and bamboo forests (see village map, fig. 2). These *sahi* were mainly divided by caste and tribal groupings, where Gopal Sahi and Dehury Sahi were dominated by non-Adivasi households from a range of caste communities, defined in government terms as being 'Other Backward Caste' (OBC). Project Sahi, Bania Pasi and Bhanda Sahi were all predominantly Adivasi communities and Gaon Sahi, the largest in the community, was a mix of households from different groups. The hamlets sat between wide areas of paddy fields, which allowed families to live in close proximity to their fields. In total, there were approximately 150 households, with many of the different caste and tribe communities having arrived in the village at different periods of its history. There were definite hierarchies and tensions between some of these groups, where the *Gowdas* living in Gopal Sahi dominated village politics. However, there was also greater social cohesion than in other villages in the area. In Simulia, for instance, higher caste households refused to share water pumps with lower caste and Adivasi people, which was not the case in Urjapur.

The background and current issues in the village were described to me by some of the older members of the community. They painted a picture of a community which, despite its perceived isolation, had evolved and changed over the years; the micro-grid was only the latest change. Tarak, an Adivasi man from Bandha Sahi, described the mythical origins of the community.

> *There were originally three Adivasi families which inhabited the village. The story goes that that a goddess from Puri was called to one of the kings in western Odisha. The priest who brought her was told not to stop or look back on his journey, but midway he got a thorn in his foot. He dropped her and she stayed at that spot. The present day village was named after the Odia word meaning 'to stumble'.*

Tarak was one of the first people we spoke to in the village. He was one of few people who had worked for the forest office, having accessed a position through the reservation system[6], and subsequently climbed the ranks to retire as a respected forest ranger in 2007. This position gave him a level of relative affluence and respect, and a generous monthly pension. The views he held with respect to current issues in the forest were in contrast to much of the community. He was a strong proponent of the village relocation proposed by the forest office, a topic which intersects with the micro-grid and will be referenced at points throughout this thesis. The forest office were pressuring the communities in the core forest area to agree to relocate, apparently so they could repopulate the area with tigers. Tarak supported this, seeing an opportunity to be relocated to a place free of conflicts with animals, better infrastructure and greater livelihood opportunities. This was a contentious issue, with most of the community being more sceptical.

Parashar, one of the oldest men in the village, spent one afternoon telling Subhra and me more about the area since independence. He also had views on the forest office, which were based on a much more cynical view. He was a religious man, and had spent his youth travelling around the state to preach and teach local communities.

> *During the British rule we lived under the kings that ruled the area, until they were removed by the British. Life was better then, if there were elephants terrorising the towns then the king would have sent his men to kill the elephants and protect the people. This changed under the British, people were expected to provide free labour and were ordered to put out fires in the forest without being paid. During my parents' time and when I was young, it was common for us to hunt boar and deer for food and we would protect ourselves from the elephants. It controlled their populations better than now… I've voted every time since I turned 18, it's very important. I remember independence, we went with our school to see Jawaharlal Nehru speak at the opening of the Talcher coalfields and inauguration of a bridge project to cross the Mahanadi river. The bridge still hasn't been completed.*

He laughed, finding this amusing and symptomatic of development in the region.

[6] The nuances and debates around the affirmative action reservation systems in India, and their impact on education, employment and wider social mobility are not explored in detail in this thesis, but feature significantly in literature on the region (see Corbridge, 2000; Chauhan, 2008).

The community was dependent on bamboo collection from the forest. They collected bamboo from the forest and shipped it along the river to Cuttack, where there were sawmills and processing plants. This was done carefully so the bamboo was not cut from the root and the forests regrew quickly. It started during the British rule and much of it was exported, but later more trucks and lorries came and the bamboo farming increased. People moved here because there were jobs and opportunity. But the bamboo reduced and the elephants and other animals encroached more and more on the village, destroying our crops. The government companies then moved to harvesting teak and other hard woods. The area became a forest reserve in 1976 and these industries were halted, but the forest office have always been corrupt.

He accused the forest office of being complicit in poaching the reserve and of establishing a nearby crocodile and gharial conservation area with the direct aim of selling crocodile skins.

There used to be jobs and stability here, it's become more remote and disconnected. Urjapur has been left behind while other areas develop, we have no jobs, roads or healthcare. It's only because of politics that we don't have grid electricity. I can meet my basic needs but I want more for my children.

Accounts from older women in the village focused on different events, particularly what was happening inside the community. Shusama lived in Bania Pasi, an Adivasi community on the road through the village, and sold jackfruits from the large tree in her garden. Her accounts of her life focused heavily on the famine that had hit the area in the 1960s.

I was married at 10 years old, and I moved to Urjapur from a nearby village. We have 1.5 acres of land which my husband farmed before he died. I had 6 children, but only 4 survived. Without crops or food reserves many in the village died, it was a difficult time to keep a family going. Most people died from overdosing on opium, not from malnutrition or dehydration, they took it to reduce the hunger pains. It's better now, we get 1Rs rice, so we don't go hungry anymore. I get a pension from the Panchayat office also.

She mentioned the Odisha state Biju Janata Dal (BJD) government's 1rs for 1kg of rice policy, notorious in urban centres as populist pandering, but viewed as a lifeline in the community. Kushama, one of the oldest people in the village, who lived in Gaon Sahi and recollected how energy had changed over the course of her life.

Kerosene was not available here when I was a child, it only came when the bamboo industry got big. It was scary when we got it, lots of houses would burn down in fires, because of the hay dangling down from the roof. We used to burn roots from the forest as candles and we would burn old rubber tyres in the fields to scare the elephants away. We used to sleep in the fields to watch over them. Now the richer families pay the poorer families to sleep on the ones on the outside of the village.

The oral histories of the community recounted by older community members were a fascinating way to gain insight into understanding the background of the village. Equally interesting and important, however, were conversations with younger people. Subhra and I particularly spent time with young women and they gave interesting perspectives on the changing social and economic landscape of the community. Much of our conversations had little to do with the micro-grid, but their stories portray the diversity within the community and highlighted livelihood patterns and social expectations across the village. These provide context for understanding the micro-grid.

Despite coming from the same village and being close in age, three young women, Jhili, Savita and Mamali led very different lives and faced very different futures. They were all 16 and, having finished or dropped out of school, decisions were being made about their futures. For the young men in the village, the expectation was that they would leave Urjapur to find work elsewhere and send remittances to support their families. Very few expected to remain in the village as farmers and parents made particular efforts to ensure they were enrolled in residential schools out with the reserve. Many aspired to own shops or taxis in nearby towns and several wished to join the police force or forest office, despite the community's tumultuous relationship with these organisations. "He wants to become a police officer so he can shoot Naxalites", one mother said to me jokingly (though very quietly) of her five year old son. For teenage girls, however, their expectations and aspirations were very different and were shaped by their family, ethnicity, caste and circumstance.

Jhili came from Gopal Sahi, the hamlet in the centre of the village, where most of the influential Gowda caste families in the community lived. However, her family were in a very different situation. They owned a much smaller area of land than their neighbours and so her parents supplemented their income from paddy farming by raising goats and working as labourers for other families in the village. Their income was precarious and heavily dependent on the season and changeable environment. Jhili was one of six children, with five

sisters and a brother, who worked outside the village as a labourer on road projects. The land her family owned was shared between her father and his two brothers, who lived in towns in other parts of Odisha.

She loved school and had an appetite for education, something shared with many of her friends in the village. They attended the high school in Simulia, but since they fell into the government classification of Other Backward Caste (OBC), not Scheduled Tribe (ST), they could not live in the tribal girls' hostel near the school (Chauhan, 2008). Instead they travelled along the 10km mud road every day on bicycles, riding in a group of 10 or 15 in the hope that it would scare off the animals in that stretch of the forest. If they were lucky, the forest officers might give them a lift in the back of their Jeep. Jhili's mother worried about her every day.

Jhili wanted to continue studying beyond the 10th standard examinations; she had an interest in becoming a teacher or a nurse. However, the costs of attending college were high and there was little support for non-ST students. No one in the family had attended college before, especially not any of the women. Her mother was impatient to start looking for a husband for her, saying if she waited too long Jhili would end up in a love marriage. Jhili and her sisters laughed about this; clearly it was an ongoing joke. Jhili said that if she had to get married, she would want to live in Angul or a bigger city. While her mother was concerned to find a husband who did not drink, smoke or chew paan, Jhili saw marriage as an opportunity to escape to the excitement of the city. She recounted their biannual trips to Angul, where her and her sisters would buy new clothes, try new foods and see new people. She admitted she would miss the tranquillity of the jungle, but was keen for adventures.

Savita came from Gaon Sahi. She lived in a large house with her extended family. Her father had worked as a watcher for the forest office, a high risk job where village men were given temporary employment to live in the forest and watch for poachers and smugglers, track animals and extinguish forest fires. It was poorly paid and of low status and with high risk of illness or injury. He had died a number of years ago and her brother had taken his place as head of the household. Like Jhili, Savita was OBC, and so, while she came from one of the more 'elite' families in the village, there were few government reservations in place to encourage her to attend school. She dropped out once she finished at the primary school in Urjapur (if it could be called that, since the teachers rarely showed up) and never attended the high school in Simulia. Her mother said that paying for her to attend high school or college

was too expensive and would have little impact on her future. For her family, it was important that women and girls were not seen going outside the house until they were married. Savita said that it would make the family look bad if women had to go out to work or if they were seen attending the market in Simulia or socialising in other parts of the village. And so, she stayed at home, looking after younger family members, preparing food and maintaining the house. Though Savita had no other choice but to be married, she had, in some ways, benefitted from dramatic shifts in the village over the previous generation. Had she been born in her mother's generation, she would have been married by the age of 12 or 13, but now few women were married before they turned 18. The reason for the shift was never fully explained, but coincided with a similar pattern across Odisha (Forbes, 1979; Paul, 2019). Women across the village were adamant that their daughters would not be placed in child marriages.

Mamali was Adivasi. She and her family lived in the only house in Urjapur not connected to the micro-grid. It was on periphery of the village with the only protection from the forest being a broken solar fence system built by the forest office a number of years before. Her family had been assigned the house and a small amount of land surrounding it by the forest office, through government schemes which entitled ST households to land. But because of this, their land was of poor quality and difficult to protect from the surrounding wildlife. The family farmed the small area of land, lighting fires every evening in attempts to protect their crops and house from elephants. They also raised goats, loaned to them from a neighbour, who took a large cut of the sale of the goats to the middleman who visited the village periodically. Their income was precarious and Mamali's father looked to her for future opportunity.

Mamali had just taken her 10th standard exams, having lived in the tribal girls' hostel in Simulia. Unfortunately, she had failed by a small margin. This meant she would need to re-sit them in a few months' time to formally pass 10th standard and get access to reserved government jobs or further education at college. She was reluctant to re-sit the exam, saying that she was not good in school and had no confidence. For her father, however, Mamali's educational prospects were of great importance. If Mamali could get a government job, such as those in the forest office or in one of the administrative offices in the district, it could transform the family from a precarious existence depending on unreliable crops and ration

cards to a stable monthly income. Mamali was interested in working, but lacked confidence in her abilities.

The life stories and profiles are interesting in many ways. They show the wide range of experiences and aspirations across this diverse community. Just like the coming of the micro-grid, the people of Urjapur have always experienced things differently depending on their age, gender, ethnicity and personal view, and they respond accordingly. They paint a picture of a life in an endlessly evolving village, which is dynamic and everchanging under its sleepy exterior.

There were also people in the community who had more direct involvement in the micro-grid, and became key interlocuters for me over the course of my fieldwork. Jaya, Ravi and Mukesh feature heavily in this thesis and are introduced here. As well as a close relationship with me and Subhra, all were central figures in the micro-grid project.

Jaya was a key interlocuter during my fieldwork. She was in her forties and from a higher caste family living in Gaon Sahi, in the centre of the village. From the beginning she acted as a self-appointed gate keeper for me, providing introductions, filling me in on village gossip and making sure we had food, water and access to toilets. She had been mentioned by the SolarFuture engineers, who painted a picture of her as the formidable matriarch of the village. In reality, she did not have a formal political position in the village, but she played a huge role in the day to day running of the village and was central to the debates and negotiations around the micro-grid.

Jaya constantly challenged expectations of Odia women. She wore men's clothes, forgoing the traditional sari worn by other women. She drove a motorcycle around the village and regaled me with stories of meeting tigers in the forests around Urjapur when she was younger (by the time I visited, it had been many years since any tigers had been spotted in the reserve). She ran the village's only *kirana* shop, which sold basic dried goods and soaps, and the ecolodge, set up by the forest office's livelihood programme, aiming to encourage tourists to visit the reserve. She ran a tight ship and would often be heard barking orders at young men who helped run these businesses. Beneath her stern exterior, she was clearly respected across the village and well-liked by women and children. She acted as an agony aunt for many women, providing a shoulder to cry on and sage advice. She cared deeply for the community and fiercely stood up for the women in particular. Though her family had not originated in the region, she strongly advocated against village relocation outside of the

forest, saying that it was their home and that they could work together to deal with the hardships of living in such an area.

I asked her how she had turned out the way she had, as such a stark contrast to many of the women around her.

> *I was always determined and brave. My father was the forester and was posted here. He made sure I completed 10th standard and got a college education. After my parents passed, Keralan nuns were working in the area. They supported me through my loss and I was inspired by their freedom. I went with them to the Catholic church in Angul and I liked the sense of community, even if I'm not Christian. The nuns told me I didn't have to get married, so I resisted family pressure.*

She lived with her brother and his family, in the house her father built; her other brothers had moved to Angul, where their children had better educational opportunities. Their father had been a high ranking forest officer and was well respected in the area. She still received his pension and this contributed to her living costs and helped to support her independence. Her family's land was shielded by other houses from elephants and animal attacks so they were able to reliably grow horticultural crops and sell them at weekly markets in Simulia, the nearest village, 10 km away. She was comparatively better off in the community, being higher caste and economically more stable. In many ways her freedom came from a place of privilege and familial support, particularly compared to other women in the village who were more dependent on their husbands and in-laws.

One of Jaya's biggest frustrations was increasing divisions within the community. In her view, the village would be most resilient and prosperous if everyone, particularly the women, worked together and helped each other. She said, "in the past, women across the community from different hamlets and different caste and family groups, would regularly help each other with farming, childcare and lend money and food to each other when needed. Twenty years ago, the political parties started coming to the village around election time. They would buy votes with mutton, liquor and cash and each party would target different caste and tribal groups." The hamlets themselves are each dominated by different caste and tribal groupings. Jaya described that, before long, divisions had created along these lines. Though the vote was targeted at men, it had spread across the village and affected many of the informal support structures between women. As she put it, "all the political parties are equally useless

and they don't help us anyway", increasing her frustration with the divisions that had come as a result.

Jaya had a mixed relationship with SolarFuture. She was the only woman they interacted with, but they viewed her as bossy and difficult. They maintained good relations with her, aware of the influence she had in the community. It was Jaya's family who owned the land on which the micro-grid had been installed, though there were ongoing debates about the payment that was expected for this (see chapter 4). Despite these tensions, she was one of the early adopters of the micro-grid. She bought a fridge for her *kirana* shop, so she could now sell milk and cold drinks and used a TV, fan, lights and phone charging on the micro-grid energy in her house. The ecolodge had been fitted with its own solar PV system by the forest office, which had been destroyed by a lightning strike. Since then, Jaya had negotiated for the TV, fans, fridge and lighting, all used for the guests of the ecolodge, to be run from the SolarFuture system.

Ravi acted as the de facto village head. His family dominated village politics; he headed the solar committee and ecolodge committee, while his brothers and cousins sat on or headed the village, school, health, agriculture, water and other committees. They also controlled many of the resources and facilities in the community. They were Gowda caste and had owned a large herd of cattle. When they sold it a few years previously, they invested in a rice hulling machine and an auto-rickshaw, the only ones in the village. Every family farming paddy, therefore, was reliant on Ravi's family to process and sell their crops. Anyone who needed to leave the village to visit Angul or Simulia for healthcare, to visit government offices or relatives, or even just to go shopping was reliant on the auto-rickshaw. In addition to this, the family owned land in the community, which they farmed paddy on.

Along with Jaya's family, Ravi's family were central to negotiations around the micro-grid. His family were politically active outside the village and regularly visited the forest office and block office in Angul to advocate on behalf of the community. They all keenly felt the state neglect in the village and I was regularly given a litany of instances where Urjapur had been given less than their due. The lack of schoolteachers, absence of road, dearth of medical services and shortages of water were commonly complained about. Ravi and his family were framed by SolarFuture as the power hungry elites in the community and, to some extent, they may have been. But they were also the most politically aware and politically informed people in the community. Ravi was by no means resigned to the political marginalisation

Urjapur experienced or afraid of rocking the boat in attempts to get Urjapur what it deserved. Others in the community had a fatalistic view of politics, seeing no relevance to their own lives and little point in engaging in conversations with the state to solve their problems and with little faith in their own abilities to impact meaningful change.

Ravi, and other members of his extended family, did not have a huge affinity to the surrounding forest. Though the close threat of wildlife was present across the village, his family complained the loudest about their effects. When I first visited one of his brothers, he immediately assumed I was from the forest office. He launched into an angry tirade about "tora barha aau tora hatti [your wild boars and your elephants]" and the damage they were causing to crops and risk they posed to the safety of the village dwellers. He was quickly corrected by Jaya, but it was clear he viewed the wildlife as being connected more to outsiders than himself or his family, in vast contrast to many Adivasi households. Ravi regularly visited the forest office in nearby Simulia to petition for a concrete fence to be erected around the village, a request that was repeatedly denied, supposedly because of the potential impact on migrating wildlife.

Ravi and his family's overt attempts to hold the government to account and to resist the attempts to marginalise Urjapur highlighted the complexities in the landscapes of oppression the village. Ravi was embedded within a local power structures where he was an elite and his drive for greater government assistance was not entirely altruistic, but his efforts were often some of the only attempts to directly engage with the government and, though with mixed levels of success, these had knock on effects across the community.

Mukesh lived with his family in Gaon Sahi with his wife, two young children and their parrot. I was introduced to him initially through the micro-grid itself. Mukesh was one of seven young men selected by SolarFuture to be trained as technicians to facilitate the basic functioning of the micro-grid and future projects envisioned for the village. Instead of migrating from the village, he had remained and did most of SolarFuture's work on the ground, in collecting payments to the grid, doing small repair and maintenance work and coordinating communication between SolarFuture and the community. They also took him to their other sites to help install projects and train technicians there, since he was often better able to connect with communities than the SolarFuture engineers. He described SolarFuture as an opportunity to support his family and to travel outside the area. Mukesh's relationship with SolarFuture, however, complicated his relationship with others in the village. Mukesh was

Adivasi. While he was not from one the poorest families in the village, his family had little social power or influence. Mukesh's close relationship to SolarFuture caused resentment from some of the more powerful families in the village, such as Ravi's. Some higher caste families refused to let him enter their houses to fix light fittings or appliances, despite him being the only person in the village with the skills to do so. Collecting the payments for the energy was especially challenging, with families treating Mukesh as a proxy for SolarFuture. He said at points he had been threatened with physical violence by some families who were resistant to paying for the energy provided by SolarFuture.

Mukesh's work with SolarFuture, though sometimes stressful, provided him with a stable income, which was supplemented by work he did for the ecolodge and other odd jobs. His family had some land, but, like most, only grew basic paddy crops which were often destroyed by elephants. He was keen to send his children to better schools outside the village, recognising the potential for education to help them. He was also keen for his wife to be trained as a solar technician. He thought that SolarFuture should initially have trained married women to maintain the system, since they were less likely leave the village as young men did. He acknowledged that he had benefitted from the other men having left, however, since it gave him more work in Urjapur.

2.4 Conclusion

These short introductions and vignettes to some of the people in the Urjapur community are by no means comprehensive or representative of all the experiences, backgrounds and opinions of people in the community. However, they aim to provide some context for readers by means of an introduction to the village. For me, the historical background and recollections of the older members of the community was an important component in understanding where people's perspectives came from and how they situated the micro-grid project within their own lives, background and experiences. Talking to younger women in particular provided a valuable opportunity to understand how people were envisaging their own futures, aspirations and opportunities, and what the diversity of this was across the community. Given that the micro-grid also proposed specific futures and opportunities, this contextualisation provides an interesting counterpoint which will be built upon throughout this thesis. These short vignettes are also important in recognising the dynamic and multifaceted nature of people's lives that went far beyond their engagements with the micro-grid project. The Urjapur micro-grid came to define the community in how they were viewed

by SolarFuture, by the visitors who came to see the micro-grid, by other actors in the assemblage and, to some extent, for the purposes of my own research. However, the micro-grid was only a relatively recent feature within the community, and not necessarily one which would have an enduring impression on it. This is not to undermine the importance of studying it, but the somewhat transient nature of the project needs to be grounded within the more situated, contextual fabric of the community.

3. Jogad, Appropriation and Development in Urjapur

3.1 Introduction

This chapter explores the development landscape of Urjapur. As well as providing an overview of the development 'issues' in the village, it seeks to understand how individuals, groups and communities within the village responded to, and participated in, development projects implemented there. It argues that development interventions across the village, ranging from philanthropic endeavours to state-led development schemes, were appropriated and remoulded to fit within existing strategies for overcoming challenges facing the community and to conform to social structures and relations within the community. This chapter aims to examine the appropriating, co-opting and mediating mechanisms at work within the community end of these projects. The outcomes explored will be those consequences, unintended by the designers of the interventions, but very much exploited by those at the user end.

This chapter uses ethnographic vignettes relating to conversations and events which illustrated the ways in which the community responded to development project. It explores case studies of key areas where development interventions seemed to be most 'impactful' (though not necessarily in the ways anticipated) in the community: the government schemes for building permanent housing; schemes and SHG projects for livelihood development; the forest office ecolodge project; and the energy based interventions in the community prior to the micro-grid. Through these I frame the processes of *jogad* as central to understanding how the community engaged with both development projects and understandings of what 'development' meant to those in the community, and aim to contribute a deeper dive into the application of existing ideas of *jugaad* within community development settings. I argue that these *jogad/jugaad* processes were inherently shaped by the social structures within the community and the different abilities of groups within the community to exercise agency over development projects. This chapter centres on many of the development interventions that had taken place in Urjapur prior to, and in parallel with, the micro-grid. It builds a framework for understanding how the micro-grid subsequently fit into these processes and structures that will be extended upon in chapter 4.

One of the key people who orientated my understanding of development projects in the community was Wamika, the community Accredited Social Health Activist (ASHA) worker. India's 2005 National Rural Health Mission (NRHM) overhauled rural health provision, instigating village level health workers through the ASHA scheme, with a particular focus on maternal and child health, to broadly positive reviews (Mishra, 2014). The scheme places the village ASHA worker at the sometimes contested boundary between state provided health provision and communities (particularly women) with existing practices, values and approaches (Roalkvam, 2014). Wamika's experiences made her uniquely placed to observe and understand both the drivers for external health based interventions and the mindsets and priorities of those in the communities.

Subhra and I first met Wamika after attending a health camp run by block health officials, who were handing out mosquito nets in anticipation of monsoon season malaria outbreaks. While the mosquito nets had been gratefully received, an argument had broken out between the officials and a farmer in the village. The farmer was angry that his neighbour had died during the/a previous monsoon season following an elephant attack. The mud road to the village had been flooded every monsoon season so it had taken over three hours to get medical attention, by which time it was too late. These conversations were common and indicative of the feelings of marginalisation and abandonment expressed most vocally by higher caste Hindu men. In an apparent attempt to redeem the reputation of the health care provision in the area, the health workers had directed me to talk to Wamika. They praised her for her role in providing maternal healthcare, diagnosing and treating malaria and promoting sanitation practices in the village. The farmer agreed that she had indeed done good work. Upon meeting her, however, it seemed her role was much more contentious. "It's difficult to keep everyone happy, I have to meet what the government expects of me, but also be careful about what the community wants," she said.

Wamika lived in Gaon Sahi, in a *kutcha* (earth) house with a small kitchen garden and outdoor toilet, just like most other houses in the village. Unlike employees of the forest office, who lived in *pucca* (brick/permanent) houses, and had motorcycles, TVs and fans, there was no obvious distinction between her and her neighbours. She said that since ASHA workers were technically volunteers as opposed to government employees, she only received a monthly stipend for the work she did. She had been trained by the same group of Keralan nuns who had taken Jaya under their wing and, like Jaya, was not shy of sharing her opinions; "I have

more status than I would have otherwise, but I am still not invited to attend community meetings, so I have to find other ways to do my work." Like other women in the community, formal positions of village leadership were off-limits so her influence was much more subtle and depended on the relationships she formed with women from all backgrounds in the village.

One of Wamika's key roles was in facilitating government schemes promoting family planning, predominantly targeting women. She critiqued these, saying, "It would make more sense for them to offer sterilisations to men, it's less invasive than for women." In addition to this, she was expected to help provide maternal healthcare and accompanied pregnant women, mothers and babies to their health check-ups in the nearest medical centre. She and the mothers both received financial incentives for attending healthcare check-ups and for accepting sterilisations and other birth control options. The range of financial incentives put her in a strange position. She trod a fine line between maintaining the trust of the community, achieving the maternal health and family planning goals of the government and sustaining her own livelihood.

> *One woman has had nine children, though one died later from a snake bite. I've tried to convince her to take [the birth control options]. The government would give her money, but she doesn't want it, even though she's very poor and can't take care of them. It's very difficult to convince people. At least her and I get incentives to go to the hospital every time for her to give birth. The progress we've made in the last 10 years is good; we haven't lost a single mother in childbirth, before that many women and babies died, but it's difficult trying to convince people to have less children, there are more factors to consider.*

She pointed out that many of the women in the community, particularly from Adivasi households, had mistrust in doctors and allopathic medicine (Bansod, 2014). She said about one woman in the village, "Her daughter in law has had several miscarriages. They came to me asking for help, and I recommended they see a doctor. But the cost to travel to get to the doctor is a lot, so they took her to type of priest instead. I don't trust him, but they thought it was the best option."

Aside from her role in maternal health, Wamika was expected to set an example for 'good' health practises. Sanitation was a critical aspect of government and NGO health policies and over the previous decade had resulted in outdoor toilets being built outside every house.

Wamika said that no one in the community used their toilets and instead used them as *godowns* (storerooms). She, however, was expected to use hers.

> *I have to use the toilet, otherwise the government won't give me my stipend. It's supposed to set an example for other people to use theirs, but they don't, they use them as godowns instead. They only built them because the government paid them to. It's difficult to get people to change their behaviour, they've been doing it this way their whole lives and they don't see a reason to change, it seems more unsanitary to them. I wouldn't if I wasn't made to by the government.*

She also mentioned that people in the community siphon off the money given to build the toilets for other purposes, resulting in poorly built toilets which lacked water connections and appropriate sewage systems.

Wamika promoted formal, government sanctioned healthcare, but that did not mean that all in the community accepted it. Adivasi women were more resistant to visiting government doctors and taking up healthcare incentives, though these were often the poorest families in the community. The value that she and the government saw in birth control was often not reflected in what other women saw and she had to navigate those relationships carefully. The ways in which the government programmes were received were considerably more complex than providing cash incentives and instead intersected with differing practices, knowledges, priorities and approaches.

Implementing agencies have often laid blame for these 'failings' on lack of community awareness, lack of education and a need for behavioural change (Saravanan, 2013). However, in order to understand how 'development' was received in the Urjapur context, there is a need to understand how decisions were made and how they intersected with the types of agency people exercised over such projects. The conversations with Wamika highlighted this, where development mandates met localised agency and were accepted, rejected and subverted. In her role, she clearly felt strongly about what she was trying to do, but was also aware of where the limitations lay.

3.2 Development in Urjapur

In conversation with local government officers, NGO workers, SolarFuture engineers and residents of Angul, Urjapur was described as "pathetic", "desperate" and "despondent". The wider area around the reserve was often featured in local newspapers, mostly to report on

social ‘evils’ which supposedly took place there: poaching, hunting, prostitution, people trafficking, drug trade and Maoist violence. Members of the community themselves also emphasised the challenges of living there, though they primarily focused on the environment challenges, financial insecurity, state neglect, lack of facilities and infrastructure and, particularly for women and Adivasis, socio-political marginalisation. The perceived development issues within the community had triggered the string of interventions in the village, some of which will be explored further in this chapter. These came through state and national government schemes, philanthropic individual contributions, NGO programmes and, in the case of SolarFuture, private sector provisioning. Urjapur was seen primarily as a set of problems, a hopeless case in dire need of external help. This commentary was common in the portraying Urjapur as a forest village in a rural, hard-to-reach area (de Haan & Dubey, 2005).

However, many of the development projects, including the micro-grid, were enabled because of its relative proximity (a 4 hour drive) to Bhubaneswar. This meant that although Urjapur was remote, it was still more accessible in terms of geography, language and perceived risk than the ‘tribal’ villages in areas of Kalahandi, Koraput and Malkangiri in southern and western Odisha, which were often characterised entirely by their levels of poverty. Urjapur presented a more accessible and ‘consumable’ kind of poverty that was representative of other parts of Odisha. This was evident in the marketing material used by SolarFuture, which emphasised Urjapur as a ‘tribal’ village, despite nearly half its residents being from non-tribal groups. By the time of my fieldwork, most government schemes were still ongoing, but NGOs and philanthropists had largely stopped working in the area. As one of the staff members from a state-wide NGO working in sanitation and health put it, “We wouldn’t work in that village, it’s had so much press from the micro-grid that we would never get any credit for any improvements.”

Beyond being people in village being ‘poor’, little attention was paid by any of the government or development practitioners who knew the area to the processes of how people did, for the most part, manage to make do, readjust and rearrange to meet their basic needs (often in spite of, rather than because of, external interference). There was little acknowledgement of the community as active agents within development projects (Cleaver, 2007) and little attention also paid to how the development projects were received and appropriated within the community and how they did, or did not, fit within the processes of readjustment and rearranging. This is not to undermine the extent of the challenges which

existed in Urjapur, nor to dismiss any desire for external assistance. However, there is an opportunity to closely engage with how development projects did or did not align with the needs and wants of the community, and the ways in which they were remoulded to suit these.

This is where *jugaad,* or the Odia *jogad*, becomes a compelling concept for understanding how development projects fitted into daily lives in the village. In Urjapur, it appeared to be practised every day. As a community, as families, as social groups and as individuals, everyone was constantly 'making do' (Singh, et al., 2012). The mechanisms by which they did so were mediated by their limitations and circumstances, and facilitated and aided by their social relationships, opportunities and aspirations (Rai, 2019). As yet, there are few situated ethnographic accounts of *jugaad* which explore the nuance of its content in the village context, with many studies focusing on its implications in business spheres (Prabhu & Jain, 2015) and specifically on entrepreneurship (Singh, et al., 2012). This chapter contributes a deep dive into some of the wider ideas around *jogad*, building on conceptualisations of it as a form of provisional or appropriated agency (Jauregui, 2014) and, in this case, a mechanism of negotiation, appropriation and redesign in efforts to navigate the power structures around development interventions. It draws on conceptualisations and understandings of *jugaad* (the Hindi term) put forward by other academics referencing the wider South Asian region as well as those of *bricolage* (Cleaver, 2012), agency (Jauregui, 2014), de-scription of technology (Akrich, 1992; Ahlborg, 2017) and participatory development approaches (Chambers, 1994; Cleaver, 1999), all developed by scholars referring to other regions of the world, but with a particular focus on Global South contexts.

Birtchnell (2011) put forward critiques of *jugaad* and the way it has been glorified as a model for a neoliberal development strategy (Jeffrey & Young, 2012), particularly in its form as 'frugal innovation' (Hossain, 2017). Instead, he asserts that the concept has come about through structural instability, precarity and power inequity. These critiques have valid ground in Urjapur, where instability and precarity were inherent to many aspects of life and arguably made the processes of *jogad* necessary. However, this concept is still helpful in understanding how the community interacted with development projects and, ultimately, the micro-grid. *Jogad* was a way for people to innovate and work around the (not insignificant) challenges of living in Urjapur. However, it also became a mechanism for them to rework external interventions in the village to appropriate these projects for their own

needs and uses. Arguably, there was also a role for *jogad* in mitigating potential perceived risks that external development projects might pose.

A framework for understanding these processes can be drawn from the conceptualisations of *bricolage* within critical institutionalism (Cleaver, 2012). Jessica De Koning describes the processes of *bricolage* within community development projects (in her case specifically referring to forest management projects) as aggregation (development interventions adopted into an existing community structure without adaptation), alteration (the processes of development interventions being adapted, changed or reworked to fit into existing community structures) and articulation (the rejection of external development interventions). Though potentially oversimplified, this framework provides an understanding of how communities respond to external intervention, with alteration particularly being central to the processes of *jogad.*

Within this, there is also a need to acknowledge and interrogate the internal social structures within the village, where individuals, households and communities had differing abilities to exercise agency over development projects. The ways in which a higher caste Hindu man could exercise agency and control over a project were different to a younger Adivasi woman, for example. This related to the types of project and also to their scales. For instance, government schemes which were implemented on a household level were received and processed differently to a community wide development programme, as will be explored in this chapter.

Wamika's experiences demonstrated the complexities within the responses and reactions to health interventions in the community. They diverge from a homogenous view of the village to one where different individuals had different beliefs and priorities. Many embraced the incentives for certain healthcare interventions, but, contrary to top-down development assumptions, others chose to reject these interventions, arguably exercising a form of agency in itself (Johnson-Hanks, 2006). This moves away from linear notions of development and aspiration, where monetary incentives are seen as a way to encourage 'the poor' to adopt certain types of health. Instead, nuance is required to understand how decisions were made and what the priorities of the community were. This was not unique to health interventions in Urjapur and will be explored in more detail with respect to other interventions throughout this chapter. Likewise, Wamika's interaction with sanitation interventions also invites us to look more critically at how and why people responded the way they did. Across India, there

is a common trope that government built toilets are used as godowns (Tiwari, 2014; Jacob & Lala, 2019), often with the implication of the lack of education in rural villages (O'Reilly & Louis, 2014). However, this could be reframed as subtle ways of appropriating agency, decision making and resistance to externalised government schemes. To most households in the community, the only conceivable function for it was as storage space. Even Wamika chose to use hers as intended primarily so she would receive her stipend.

There are potentially contributions to be drawn from participatory development methods (Chambers, 1994). The examples used in this chapter emphatically did not use participatory approaches. The central government policies could not be further from this; they were carbon copies of the same programme implemented in hundreds of thousands of villages across India. Arguably, they may serve best to support arguments that participation is necessary for development projects, though the concept is not without its critiques (Cleaver, 1999; Kapoor, 2002). However, just because these projects did not explicitly anticipate 'participation' does not mean the community did not participate in them. The projects were often implemented at arm's length, with little direct or sustained interaction between the communities and the implementors. This was particularly pertinent in the Urjapur context, where the local Panchayat Development Officer post was empty, schools had no teachers and the health centres had no permanent staff. As such, interaction with the state or NGOs on development projects was intermittent, infrequent and unpredictable. This absence seemed to open up greater opportunities for the projects to be remoulded and repurposed to suit local needs, as a form of participation. This also relates to David Mosse's work on the relationships between policy and practise, whereby he argues that development practice is driven less by policy and more by the relationships between actors involved (Mosse, 2004). Here, the original policy or design of development interventions were often disregarded and abstracted through iterations of *jogad*, often facilitated by the types of relationships which did or did not exist within the community and with external implementors.

The following case studies provide examples of how the processes of appropriation appeared to be enacting in Urjapur. I do not attempt to fully or objectively understand the impacts of the various development interventions examined. Literature looking at the impact of, and contentions around, such projects in comparable contexts will be indicated. The outcomes of these projects, however, provides an interesting and pertinent framework for understanding how the micro-grid was received in the community.

3.2.1 Indira Awaas Yojana Housing Scheme

Subhra and I visited Project Sahi early on one of our first days in Urjapur. It was on the outskirts of the village and had apparently been built to house the workers who moved to the village as part of the bamboo trade and canal projects in the area, both of which had long since ended. As in many villages, it was those of lowest caste and tribal status who lived in these peripheral settlements (Das, 2001). Jaya told us it was one of the poorest *sahi* in the village, but that the people there were friendly and would be happy to talk. It was close to the edge of the forest and so, while beautiful, was vulnerable to marauding animals from the forest. Indeed, as we arrived, a young woman ran out and told us to be careful, there had been three elephants passing through just half an hour previously.

Most of the houses in the *sahi* were *kutcha* houses, made from mud walls on a bamboo frame and thatched with dried paddy. Alongside these, there were also two pucca houses, made of brick, but uncompleted. Both lacked a roof, doors, windows and parts of the walls, but had Odia lettering painted on the outside. Intrigued, Subhra and I asked the young woman who was showing us around. She introduced us to a woman in her forties who told us more about the house.

> *We live nearby in a kutcha house and we have half an acre of land where we grow paddy and raise chickens. But last year there were elephant attacks in one of the other hamlets and one of the houses got destroyed. We live on the end of the village and we were scared because there are a lot of elephants here, so we thought a pucca house would be safer.*

We asked her how she built the house, and why it had the painted lettering on the outside. She answered, “My husband and I built it through a government scheme, Indira Awaas Yojana, we started it a year ago. We got Rs 75,000 from the government and had to contribute Rs 15,000.”

Jaya came to join us and explained the details of the scheme. The other woman nodded along; it was clear Jaya often acted as a go-between in interpreting the intricacies of government schemes for people in the village, “Anyone living in a kutcha house can access the scheme and there are other ones at state and central level. You have to prove land ownership rights for the property and they send the money directly to the bank accounts in instalments. But there are problems in completing them.”

We asked what she meant and the other woman replied, clearly stressed

> *We took the money from the government in the first two instalments to build the house. We started building with help from my husband's cousins. Then my husband became ill and we had to use the money to cover medical costs, like the transport to and from the hospital in Cuttack. Before we get the final instalment, the block officer will come to take pictures, but he'll see we haven't built it and we won't get the final instalment and be able to finish the house.*

We asked her what she was planning to do, and she said, "My son works in a roadside *dhaba* [restaurant] near Bhubaneswar, when he sends money we'll complete the walls, but the house has to be completed within a year from the start date and it's already been too long. We're concerned they might ask for the money back."

After that exchange, I started to notice numerous part-finished *pucca* houses across the village. They were all completely empty. The stories told by owners were similar; the money from the scheme had been used for other purposes. For some people, it had been an emergency measure, but for others it was a well-planned mechanism to access a quick loan.

The *Indira Awaas Yojana* (IAY) Rural Housing scheme was rolled out in 1985 by then Prime Minister Rajiv Gandhi (named, like numerous government schemes, after his mother). It was subsequently restructured and relaunched in 2015 by PM Modi as *Pradhan Mantri Gramin Awaas Yojana* (PMGAY) and remained prevalent in villages across India (Ministry for Rural Development, 2014). There were numerous other state-specific versions of the scheme, all of which applied to different groups with different income levels and reservation statuses (Sivam & Karuppannan, 2002). In Urjapur and many other villages I visited it was referred to by the acronym of its former alias, IAY, and so will be referred to as such here. The aim of the scheme was to replace traditional *kutcha* houses with 'permanent' brick *pucca* houses (Mahadeva, 2006).

On the drive to Urjapur from Angul, particularly after entering the tiger reserve, there was a gradual shift in the proportion of *kutcha* to *pucca* houses, with the villages nearer the main roads and reserve entrance being made up of mostly *pucca* houses and those further inside the reserve mostly *kutcha* houses. This followed a visible correlation in the prevalence of government schools, health centres, grid lines, mobile phone masts and even roads, all of which petered out further into the reserve. It seemed that this was indicative of the reach of

state care, where perceptions of state neglect were keenly felt in Urjapur and other nearby villages deep inside the forest. Completed *pucca* houses had painted lettering on the side of them, detailing which scheme had built them and how much money had been provided. Similar lettering was found on the side of community centres, schools, (mostly defunct) e-learning centres and toilets built through government schemes. This branding in and of itself seemed like a state marker (Brow, 1988); an assertion of state provisioning in places that felt on the periphery of any type of political power.

The scheme, and its many iterations, were a staple feature of the Indian rural landscape. *Pucca* houses join the many infrastructural representations of progress and modernity, alongside grid electrification lines, tarmacked roads and phone masts (Edwards, 2003). The critiques of the scheme, originating both in scholarly work as well as in public discourse, focus mainly on inclination to corruption (Witsoe, 2012) and, like many central government schemes, its lack of adaptability to local contexts (Patil, 2015). Akhil Gupta highlights the scheme in an anecdote in his article, *Blurred Boundaries: The Discourse of Corruption, the Culture of Politics, and the Imagined State* (Gupta, 1995). He explores the hurdles of accessing funding for the scheme in a village in Uttar Pradesh, where its recipients struggled to access the government funding for it, particularly those who lacked the networks and connections required to navigate the system.

In Urjapur, however, the role of IAY had been changed. It was not that challenges in accessing government schemes and in navigating state bureaucracy and corruption did not exist in Urjapur; there was no shortage of anecdotes about government officials skimming off portions of compensation, pension and other welfare schemes. However, this scheme seemed more accessible and less prone to corruption than in Gupta's account. With the relaunch of the scheme by Modi, the money was transferred directly into the recipient's bank account (Ministry of Rural Development, 2016), leaving fewer opportunities for localised corruption and less reliance on the social connections and middle men that have come to define the processes of accessing welfare in India (Gupta, 2012)[7]. The new scheme prohibited the use of contractors, notorious for perpetuating corruption in government infrastructure

[7] The role of PM Modi's shifts towards e-based welfare provision and direct transfer, purported as attempts to reduce ground level corruption (Das, 2016), possibly have a role in the changing ways in which people could mobilise government schemes for different purposes.

projects (Shah, 2010, p. 67). This development also shifted how households could make use of it.

In Urjapur, however, the interest in the scheme was not centred around aspirations for 'improved' housing. There was little appetite for building *pucca* houses and so the community themselves appropriated the scheme to leverage their own outcomes and benefits. While around 30 households had *pucca* houses of some form, almost all were empty, and it was clear why. Particularly at the height of summer, the brick buildings allowed for little airflow through them and, with temperatures approaching 50°C, they were extremely uncomfortable, if not dangerous, to spend time in. The *kutcha* houses were breathable and well adapted to the local environment, having been built, designed and redesigned in the region over generations. They also had sentimental value, particularly for older community members. Often the men who built the *kutcha* houses, if deceased, were remembered through the building itself (Gibson, 2010); widows would sometimes say, "I like living in my house because my husband built it before he died". Though the *kutcha* houses required upkeep, this upkeep played part of communal life and seasonal change, with neighbours helping each other to rethatch roofs at the beginning of summer and re-plaster walls and floors throughout the year. This is not to over-romanticise the traditional houses; there was anxiety about the constant maintenance and concern over the vulnerability to animal attacks, flooding, storms and other extreme weather events. However, few living in Urjapur expressed an urgent desire to change their building practices and living habits. In discussions about issues in the community, the quality of housing rarely came up.

The IAY scheme was, however, still relatively popular. Few families had access to large amounts of money to fund weddings, funerals and festivals, which were expected to feed hundreds of people. Some families had financial barriers to accessing healthcare and, with no locally accessible government hospital, treatments for certain common ailments, such as infertility, sickle cell anaemia and fever, were prohibitively expensive. Even accessing government hospitals was relatively expensive, requiring long distance transport and accommodation costs. Some families wished to invest money in new livelihood opportunities, such as agricultural machinery, but could not afford the upfront costs. The cobbled-together mechanisms for making enough money to live day to day left little leeway for emergency funds or large scale payments. In some families, in years gone by, they had had to sell property to afford medical care and funeral costs, thus diminishing future financial

security. In place of this, the IAY scheme became part of the mechanics by which families could raise money for both planned and unforeseen circumstances.

The scheme was open to anyone living in a *kutcha* house, with allowances and priorities given to Scheduled Caste and Scheduled Tribe families, manual labourers, families with no literate adults and women headed households (Government of India, N.D.). The households were identified for this on the national census and then verified through the Gram Panchayat. Based on that list families could apply for the IAY money through the Block Development Officer, who visited Simulia once a month to dispense pensions and other welfare payments. The vast majority of households in Urjapur were on this list, barring those who had a motorcycle or autorickshaw or were government employees (part of the criteria which excluded people from the list). The money was transferred directly to recipients' bank accounts, after the block officer had taken photos of the recipients in front of their current residence, to load onto the AwasSoft mobile app (Misra & Mittal, 2019). The money was transferred in three separate instalments. Families categorised as Scheduled Caste or Scheduled Tribe, which was the majority in Urjapur, could get up to 1 lakh Rs (approx. £1000), distributed in larger portions than would otherwise be attainable. Of course, the money provided to households for IAY houses was not without strings attached. Households were expected to contribute a portion of the building costs and were required to provide proof that the houses had been built (presumably to preventing people from siphoning off the money in this way).

In Urjapur, once the money had been spent on weddings, to finance healthcare or invest in a new livelihood opportunity, families still had to piece together ways to complete the buildings. Many women took loans from SHGs and family members with building skills (often living outside the village) were enlisted at a lower cost than hiring local labour. This rush to finish the houses often resulted in poorer quality buildings, sometimes lacking windows, doors and adequality finished roofs. I had a number of conversations with families who had spent the IAY money in times of emergency and were struggling to find the means to finish them. However, the IAY money had served the purpose that was seen as a more urgent priority. The outcomes of these schemes were not the 'failure' of the government scheme, but a repurposing of the opportunity and an appropriation of the aspects of the schemes which were useful and a benign rejection of the parts which were superfluous.

On occasion, the IAY houses themselves did have value that went beyond the financing capacities of the scheme, but these too were far from the 'modernising' aspirations of the scheme's designers. One woman said that she was happy to have a completed *pucca* house because that it would attract a better bride for her son, who would live there in future. She had no intention of living in it herself. For some specific purposes, the *pucca* houses held a symbolic value more akin to conspicuous consumption than to explicit developmental outcomes.

For more affluent and powerful households, *not* accessing the scheme was also symbolic and had a meaning of its own. Ravi's family, one of the most powerful in the village, were in the process of building their own *pucca* house. They were financing it with much of the wealth they had gained from selling their cow herd, not through the IAY scheme. Similarly, Jaya's family were in the process of constructing the first and only two-storey building in Urjapur, entirely self-financed. Jaya's family continued to live out of a collection of *kutcha* houses nearby and were in no hurry to move into their new house. Jaya herself said she had little intention of moving into the new building, preferring the *kutcha* houses they already had. However, for the more affluent families, these *pucca* houses not built through the IAY scheme were arguably a way to display their wealth and status. In a way, their decision to not participate in the scheme was a way of leveraging an alternative outcome from the interventions.

The ways in which the IAY programme was used in Urjapur demonstrated the capacity for it to operate within a constellation of meanings far beyond their practical intended purposes. Not only were people using pragmatic approaches to extract 'useful' outcomes from it, they were also deconstructing its fundamental meaning. The ideas of 'development' that came from it were being challenged from multiple angles; from a form of stability in accessing what was effectively a loan at a difficult period of time to using the scheme to demonstrate a level of affluence. Aside from this, the ways in which the people in the community deconstructed and reformed the scheme highlighted the failed logics in it as a development intervention. The programme did not make much sense in the local context and so was subverted to a point where it did. These kind of negotiations with development interventions, which I term as forms of *jogad*, were visible in numerous other ways across the village.

3.2.2 Livelihoods & SHGs

Without exception, individuals and households in Urjapur cobbled together livelihoods and survival strategies through whatever means possible, creating individualised patchworks of income portfolios which varied throughout the year and across the village. No household depended exclusively on agriculture or one source of employment to get by, instead employing methods of livelihoods diversification (Ellis, 1998). Even those who had been employed by the forest office and had a full state pension invested in agricultural pumps, livestock and micro-enterprises to diversify their income. This approach made sense; risk and precarity in a place like Urjapur was high. No one wanted to depend on the income from crops when there was a high likelihood of them being destroyed or failing to grow due to lack of water. Likewise, daily wage work on other farms, with the forest office or in the construction industry was precarious and unreliable, so families made sure they had other means of income if these fell through.

These precarities, and responses they evoked, are reminiscent of some of the inherent risk described by Birtchnell with respect to *jugaad* (2011). This approach to cobbling together livelihoods also displayed many of the critical aspects of *jogad*. They involved appropriating opportunity where it arose and mitigating risk and limitations (be they economic, social and political) where necessary. They required the deconstruction and subsequent re-engineering, re-scripting or *bricolage* of structures, institutions and technologies to navigate life. These approaches changed and shifted in response to circumstance and were inherently shaped by the social position, gender, caste and identity of the individuals and groups participating and involved the materialisation, re-materialisation of existing objects and restructuring of existing structures.

From conversations about the histories of the village, it was clear that approaches to livelihoods and security had shifted significantly within living memory and, thus, changed how people navigated them. Older members of the community remembered the affluence of the region during the height of the bamboo industry, where people moved into the village to pursue jobs; a far cry from the seasonal outward migration from Urjapur now. Others claimed that animal attacks on crops had increased, reducing the security of agricultural dependency and the opportunities for profitable farming. However, for many of the Adivasi families in particular, drought, famine and disease in the 1960s was well remembered. It was since the introduction of, and access to, several welfare schemes and rations that many said

they felt more secure. However, how these welfare schemes were navigated, as with the housing schemes, still showed elements of appropriation of agency and *jogad*.

Agriculture was a staple for every family in the village. Everyone either cultivated their own land or had family members who worked as labourers for other families. Urjapur farmers were overwhelmingly dependent on rice farming. Everyone grew paddy and for most, this was their only crop (though some had small kitchen gardens closer to their houses). Some boiled, stored and ate the rice at home and others sold it. Most supplemented this with fruit and vegetables collected directly from the forest and produce bought at the weekly market in Simulia. All households in Urjapur had BPL ration cards and so could access the 1kg for Rs 1 rice schemes from the ration shop, also in Simulia. Everyone bought the largest quantity of this they could, meaning they were growing rice, but also buying it, and must have had much more than they could eat. Rice was a staple, but it was not the only thing people ate. At first, Subhra and I were confused about why farmers did not diversify their crops. There were many things that would grow under the climatic conditions, which could be eaten at home or sold as cash crops. Subhra, in particular, was frustrated; in her 'native' (ancestral) village, farmers had done well growing sugar cane, horticulture crops and pulses and she thought this was a missed opportunity.[8] Subhra regularly asked people directly why they did not plant other crops, but most women we spoke to shrugged and said their husbands made decisions on which crops to plant.

Eventually we spoke to a young farmer who had returned to the village for the planting season. We asked him why he chose to only plant paddy, when other crops could be sold for considerably more at the market and rice could be bought so cheaply at government ration shops. He explained.

> *Paddy is the cheapest thing to grow, it's rain-fed and we can plant it straight into the field. If the elephants and boar will destroy part or all of the fields anyway, why should I bother spending more money or time planting things that might make me more money? The compensation we get from the forest office is per acre, regardless of the crop, and even then, they try hard not to pay us what we are owed.*

[8] This frustration was shared by the designers of the micro-grid, who planned to install smart agri-systems for crop diversification in the community. This is explored more in chapter 7.

He showed us his fields and even early on in the growing season there were already large elephant footprints across one side. He said those plants would not recover and he would not get a harvest from them. He anticipated more being destroyed before they were fully grown. In every household, without fail, we heard frustrations about animals destroying crops. We asked him why he bothered planting anything at all and he explained that in order to receive forest office compensation for damaged crops, there had to be proof that the land had been cultivated. A representative would come from the forest office and take pictures of the fields to ensure no one was fraudulently claiming compensation. However, he said that persuading them to come took a lot of effort and that he had frequently found that a portion of the money he was entitled to had been skimmed off before it reached him. His decisions on what to plant were reflective of the realities of cultivating the area and the opportunities for the highest, most secure income from it. In effect, he had shifted to farming government compensation more than actual crops. Though not without limitations, the decisions he made allowed him to appropriate control over the situation, to 'play the system' and to minimise losses. The question Subhra and I should have been asking was more along the lines of, why would anyone plant anything other than the cheapest crop, when it would inevitably be destroyed and they would never be compensated for anything more? The farmer's approach to accessing compensation seemed reminiscent of the strategies for using the IAY scheme in the adaption which took place to maximise the opportunities from it.

Critically, however, it should be noted that alongside efforts to minimise the losses from animal attacks through government schemes, some residents of Urjapur were more active than others in how they appealed to the Forest office with respect to animal attacks. Higher caste men from the Gowda family in Gopal Sahi were more confrontational in their attempts to petition the forest office and block office for greater protection and compensation for animal attacks. They were primarily the people who would complain vocally to the government about the siphoning off of compensation payments, making almost weekly visits to the block office in Angul to demand fences around the village, crackers to scare off animals and greater compensation for agricultural income lost. They also participated in strikes and roadblocks to protest about the animal attacks.[9] It was unclear how effective this was; no progress was made on any of these requests in the period I was there, but it did indicate who in the village had the status and confidence to even attempt these measures. Other farmers

[9] More detail on this is provided in chapter 5, which focuses on the relations between the forest and the community.

from less affluent, lower caste and Adivasi backgrounds still subverted the processes of government compensation, but they rarely, if ever, partook in efforts to readdress the power imbalance. This was indicative of how different parts of the community had differing abilities to respond to development issues and their proposed solutions.

Another key development intervention in the community were the women's self-help groups (SHGs).[10] Almost every adult woman in the village was part of an SHG, though some were more functional than others. Most of the groups had been established by an NGO that used to work in the village and were usually organised along community and caste lines. The NGO had apparently set up the SHGs to help women fund small businesses. They were initially given support in setting up poultry and fish farms, all of which failed, mostly because of cyclones and flooding. These left the women indebted to the banks who had given them loans and caused resentment towards the NGOs. Women who had taken out loans had often defaulted on them and been left in debt. Broadly speaking, many of the programmes set up by the NGOs through the SHGs seemed somewhat disastrous, with none of them surviving by the time I was on fieldwork. Nevertheless, the SHGs themselves remained long after the NGOs had left the village.

In a place where saving up money was difficult, SHGs provided an alternative way for women to access larger funds outside of their patchwork of income streams. Often used as a supplement to money accessed through IAY and toilet schemes, loans taken from the SHGs were used for a number of purposes. Some used money from such groups to pay for weddings for their children and to contribute to dowries for their daughters. They were also used to contribute to festivals and funeral costs. Other used it to pay school fees for students educated outside the village and a few used it to buy radios, TVs or fans to run on the micro-grid. In a few ironic cases, women took money from the groups to fund the building work needed to prove to the government block office that the IAY money had, in fact, been used to build a *pucca* house. Because the SHGs operated within the existing caste and class groups in the community, they seemed to be more accessible to women operating within those groups and did not require them to engage with the wider village power structures.

[10] There is significant literature about the role of SHGs in development in rural South Asia relating to both their role within micro-finance programmes (Deininger & Liu, 2009; Swain & Wallentin, 2009) , and within social 'empowerment' (Jakimow & Kilby, 2006; Tesoriero, 2006), which are largely beyond the scope of this thesis.

The SHGs seemed to provide and strengthen the identities of women and acted as a social space and place for solidarity and support, but also sometimes of conflict. In one instance, I was having a conversation with a group of women living in Dehury Sahi. Confused by the repeated mention of SHGs but the vagueness of any details around them, I had asked them what they used SHGs for and how they worked.

One woman started explaining to me, “Each month everyone in the group contributes Rs. 50, which is deposited in the bank. Everyone who contributes can take out small loans which they were then expected to pay back, with interest.” As she was explaining, another woman interrupted, complaining about misuse of SHG funds, “Some people take money out and never pay it back. The group will collapse soon.”

She seemed to be talking about someone specific, and when Subhra asked what the money was used for, we were met with laughter. Eventually it was explained that this woman was using the money from the SHG to fund a small, informal business providing illicit supplies of alcohol and opium to the addicts in the community. The other women, though amused, seemed more concerned with her lack of promptness in paying back the loan than with the ethics of her business. It was a source of amusement, particularly when compared to the projects the NGO had initially proposed.

Here, again, we see how the development interventions in Urjapur were appropriated by individuals and groups to serve the purposes of daily life. It fits well within the ‘frugal innovation’ hailed by proponents of the *jugaad* movement, displaying an impressive entrepreneurial spirit. However, again, the uses of the SHG programme diverged significantly from normative expectations of what the groups would do for development in the community. Where women had the power to do so, they leveraged the systems to suit their own needs and to exploit their own opportunities (in this specific case, a small-scale opium demand in need of supply) within the framing of limitations on their lives. More generally, though, the SHGs had taken on a life of their own beyond those intended of the NGO, one that gave women the opportunity to subvert the wider social structures and gain independent incomes.

3.3.3 Ecolodge

Prior to the micro-grid the ecolodge was the flagship development project in the village. Built in 2011, the ecolodge was constructed by the Odisha Forest Development Corporation

(OFDC), supported with funding from JICA and GIZ. It was built as part of numerous schemes across the reserve which aimed to provide employment opportunities which would reduce dependency on, and subsequent degradation of, the forest (Vinodan & Manalel, 2011; Kala & Maikhuri, 2011). The ecolodge was sited at the highest point in the village, next to Gopal Sahi, with beautiful views over the fields and into the dense forest surrounding the village. At night, guests could watch the stars and sit by a campfire. The cottages and tents were furnished with mosquito nets, 'western' toilet facilities, solar lighting and fans. They were orientated around central dining and seating areas, where guests were checked in, served food and invited to relax and watch TV. In winter, men from Urjapur would entertain guests with traditional music and songs. The lodge was run primarily by Jaya, with Ravi and Mukesh and others from the community also working there.

Throughout the year there was a steady stream of guests rolling in from Kolkata, Patna, Vishakhapatnam and Bhubaneswar, keen to spend a weekend in 'the wild'. They mostly drove flashy four-wheel drives, kicking up dust in the road as they drove through the village to the lodge and dressed in designer clothing. They rarely stopped in the village or interacted with its inhabitants beyond those working in the lodge. Those running the lodge were keen to cater to the quaint, romanticised version of an Indian village (Gupta, 2005). In one conversation with Ravi, he said, referring to the mud road linking Urjapur to Simulia, "We would like it to be tarmacked, so it won't get flooded in monsoon and we can travel easier. But some of the guests like having the mud road, because it's exciting for them, they feel like they're properly in the forest. Maybe we should leave it as it is to attract more guests."

The middle class, urbanite guests were a source of both stress and humour; once the guests had gone, they would joke about their outrageous requests and complain about the ruder guests. After a particularly stressful group Mukesh said, "They don't seem to realise we're in the middle of the forest, they ask for phone reception and outside food. We do the best we can to keep them happy though." Despite this, Ravi, Jaya, Mukesh and others working in the lodge valued the opportunities they brought. On one occasion when the forest office officers visited the lodge, Ravi spent an entire afternoon persuading them of adjustments to the lodge to attract more visitors. He wanted to plant trees inside the compound with information boards so the visitors could learn about them and the nearby animals. He was keen to extend the music and dance performances for the guests and to introduce them to more food collected from the forest.

We had a conversation with Jaya about how the ecolodge had been set up.

> *I was chosen to run it by the OFDC [Odisha Forest Development Corporation] because I had higher schooling than others and could do accounting. Everyone chosen to work here was taken to Cuttack for a 20 day training in hospitality before it was opened. The lodge and everything in it was built by the OFDC, they take some of the profits, then we are paid and the rest goes into a community fund. All the bookings are done through them, but we are responsible for cooking and cleaning here and day to day maintenance. The women who cook are the best cooks in the village, everyone knew who they were. The cleaning of rooms and toilets is done based on caste. Overall, we're happy the lodge came here, but the biggest issue is that we only get paid if people stay, so it doesn't provide much security during the summer and monsoon seasons when no one comes.*

The ecolodge operated a small guesthouse and camp for tourists visiting the reserve. In some ways, it was one of the more successful development projects in Urjapur and by many accounts was much more successful in Urjapur than similar projects in the surrounding villages, where community members had little interest in running them. Its success in Urjapur reflected its continued functioning and the money it brought in, particularly to those in the community lucky enough to get employment from it; it would be impossible to comment on the impact on the forest itself.

The ecolodge was a good opportunity to understand how development projects were mediated in the wide community as a whole. Ravi's willingness to appear less 'developed' in order to attract more income demonstrates some of the complexities and contradictions to 'development' in Urjapur; in a strange way, appearing less 'developed' was something to be exploited.

The ecolodge was by no means an equalising project. It was mapped onto the hierarchies of the community, where those of higher caste, with more social and political power, took on roles which strengthened their positions. The ecolodge employed six people to serve meals, check guests in and out and run the business. With the exception of Mukesh, they were all from higher caste, powerful families with significant sway in the community. Those controlling the lodge gave the lowest status roles to those at the bottom of the social hierarchy. Though the benefits of the project were, to some extent, proliferated more widely through the community, by means of redistribution through the community development

fund, the direct benefits stayed within the community elite. The community fund was under control of the eco-development committee, which, like most committees in the village, was dominated by the same families who controlled the ecolodge itself. It was a clear example of 'elite capture', where those in power in the community were able to leverage the opportunities from the project to a much greater extent than those who were marginalised (Platteau, 2004). It also enabled a form of gatekeeping, whereby the power of the dominant elite could be reasserted over incoming resources and opportunity (Pattenden, 2011).

In the process of the power attached to the ecolodge being appropriated, the space itself was significant. Its position at the highest point in the village evoked images of a castle sat on top of a hill. It acted as a gateway to interactions with visitors; the forest officers would meet the community here, guests rarely left the grounds of the ecolodge, except in cars and the SolarFuture team would set up base there when they visited. As such, they gave those working there more opportunities to interact with these people, thereby monopolising relationships with powerful externalities. Community meetings and development camps were the few occasions where Jaya would welcome the community into her pristinely kept ecolodge. The rest of the time she would chase anyone off unless they had a good reason to be there, particularly the young men who wanted to come and watch the TV. Thus, not only was it the mechanism through which those with influence could get jobs and power, but also a physical space where the interactions with, and access to, outside influences were mediated.

The ecolodge serves as an example of how some development projects in Urjapur were unavoidably mediated and appropriated by the community as a whole and therefore mapped onto wider community dynamics. Jaya and Ravi were both equipped with the ability and the agency to interact with the government groups who established the project and were therefore able to exploit the opportunities it gave them. This is not to say that they did not 'deserve' opportunities from the project; 'elite' was a relative term in Urjapur, as evidenced by their treatment by the middle-class patrons of the ecolodge. However, the project was Urjapur-'ised' when it was installed in the community. Whereas other projects entered through households, individuals or sub-groups within the community, the community-wide projects would always be subjected to community social hierarchies. The varying scales of interventions changed how they were appropriated and the effects of them. It also changed who in the community had the opportunity to participate and exercise agency over specific

projects. This relates back to the literature and ideas around 'participation' mentioned earlier. The engagement with the community as a whole was far from a democratic exercise, it was dominated by the community elites and the outcomes reflected this (Mosse, 1995; Cornwall, 2008). Those who participated were from a very specific part of the community and this left very little space for others to partake in the shaping of the intervention. That this project was considered to be such a resounding success, to the point that the local MLA came to visit the lodge with district officials and high ranking forest officers, might indicate a lack of interest on the implementors' part in disrupting the existing power structures or an oversight into the deeper structural inequalities existing both within and without the community, a theme that carried into the implementation of the micro-grid.

3.3.4 Energy

The micro-grid was by no means the first energy-based development project in the community. The village had no main grid connection; it was forbidden under central government legislation which prohibits grid lines running through core forest areas. Nearby Simulia (which was just outside the core forest area) was electrified in 2011 and at this time the plans were for the grid to be extended to Urjapur. Electricity poles had been installed and households were fitted with metering equipment. However, according to people in the village, SolarFuture and government officials, at the last minute the Supreme Court in Delhi ruled against electrifying core forest areas[11] and Urjapur was left, quite literally, in the dark. The grid electricity provided in Simulia was of notoriously low quality, with week-long power cuts following every rainstorm and unpredictable and unreliable power the rest of the time (Graber, et al., 2018). Regardless, the differential access to grid exacerbated tension between Urjapur and Simulia, with Urjapur residents accusing those in Simulia of having deliberately stopped the grid connection to keep the power for themselves. This added to existing resentment between the two villages surrounding unequal employment opportunities and

[11] This version of events was recounted to me by numerous sources; however, I have been unable to source the ruling itself. Developments around electrification in the area that took place after my fieldwork period (see conclusion for details) indicated there may have been more to this story and the reasons why Urjapur was left off-grid were somewhat more unclear.

Figure 5: Abandoned transformer.

access to government provision, which were said to disproportionately benefit Simulia (Aklin, et al., 2018).

The remnants of the ill-fated grid connection project in Urjapur were still visible. When the forest legislation was passed, construction was immediately halted, but none of the materials for erecting the grid connection were removed. The electricity poles were eventually repurposed by the implementors of the micro-grid and still crossed through paddy fields to reach the entire village. Each house had a meter fitted into the mud walls, which fulfilled no purpose and was largely ignored. Other parts of the grid infrastructure, however, had been appropriated in other ways. One Adivasi household in Bhanda Sahi had taken the sizeable grid transformer from the planned substation and kept it in their courtyard, hanging washing off the coils and switches (see figure 5). The woman who lived there did not know why her husband had taken it or what he had planned to do with it, but said that he had been

frustrated when the grid project fell through and so took it. She found it funny and the transformer became something of a consolation prize for the lack of grid access. She said it had been in their courtyard for so long that it became a piece of furniture and she liked how it looked. It was possible her husband had planned to sell the transformer or its parts; he worked outside the village and so was not there to ask. However, the transformer had a kind of symbolic value and presumably represented some kind of compensation for the lost grid connection opportunity and a way to get something back from the government. This act of defiance was small, but symbolic.

Figure 6: Assorted solar items.

There were parallels in how the community exploited other available energy resources. Most households in the village qualified for kerosene rations. Few people regularly used kerosene once the micro-grid and solar were installed; it was dangerous and impractical in thatched houses and I was told many stories of houses having caught fire in the past. Still, most families with ration cards nonetheless went to Simulia to collect their kerosene rations on a monthly basis. Some said they used them when the solar did not work or when they did not want or could not pay for the solar, but many admitted that they collected the ration purely because it was an additional way of extracting their 'due' from the state. The way in which communities still made use of this kerosene subsidy challenged many of the wider assumptions that solar electrification would eradicate the use of such government schemes (Narula, et al., 2012).

In place of the grid, an abundance of solar products had been bestowed on the community from various state groups, NGOs and local philanthropists. Every household had a bizarre assortment of small solar panels on the roofs and an impressive array of solar lanterns, torches, radios, light bulbs and cookstoves inside (see figure 6). Many of these were non-

functional, and even if they worked, were often discarded for their lack of useful purpose. The household solar items were designed in such a way that they could rarely be repurposed to fulfil other uses and so they were simply rejected (Cross & Murray, 2018). Some were adopted by children as toys; with some imagination, a plastic solar lamp and wiring can easily fill in for a toy truck. No one attempted to sell any of the solar items; the sheer quantity of them distributed by NGOs and government departments had reduced their resale value to almost nothing, and they were seen as worthless both within and outside the village.

As part of their efforts to placate the community for their lack of electricity access, the forest office, in conjunction with the Odisha Renewable Energy Development Agency (OREDA), the state government department responsible for renewable energy, had also installed home light systems in each of the houses in 2012. These consisted of two light bulbs and a phone charging point. They produced very small amounts of power and were direct current (DC) systems, so there was no potential for them to be used for any other appliances or uses, making them a poor imitation of the grid. Many broke quickly and apparently there was nowhere to get them repaired or replaced. The few which still worked were regularly used, even after the micro-grid came, as they were free of charge.

The forest office had also installed solar streetlamps throughout the village, the majority of which were broken. However, occasionally the lead acid batteries from these streetlamps cropped up inside people's homes. Upon further questioning, it seemed that the batteries inside the solar streetlamps were deemed more useful than the street-lighting itself. It was unclear if the streetlamps had become broken because the batteries had been removed, or whether they had broken down and the batteries taken out to be repurposed. The batteries could be charged using any of the plentiful solar panels in the village, and then used to power music systems and radios, particularly for festivals and weddings, but also for day to day entertainment. It sometimes felt jarring to walk through the picturesque, stereotypical Indian village, surrounded the serene wilderness to the blasting Bollywood songs coming from mud thatched houses. However, in many ways this perfectly captured many of the incongruities of life in Urjapur. Prior to the micro-grid there was no way to play music or listen to the radio, so the materials and opportunity to do so by other means had been appropriated to an end which was valued in the community. The potential for solar streetlights to make communities safer has been emphasised, particularly for women, within development discussions around energy (Cecelski, 2000; Clancy & Skutsch, 2003; Gillard, et al., 2019). This could well be

accurate and could even have had relevance in Urjapur. However, in this case, a decision had been made that music and entertainment were more valued. No one complained specifically about the lack of streetlights and it was predominantly women working at home who used the music and radios on a daily basis. This process of readjustment and appropriation was one of practical reengineering, but also challenged the social assumptions made by the designers of the intervention.

For cooking fuel, the surrounding forest largely met most of the community's needs. It was a common sight to see groups of women carrying bunches of twigs out of the forest and men pushing branch-laden bicycles over the dirt track to the village. These were used to run traditional stoves built into the verandas or courtyards of the traditional mud houses in Urjapur. These were constructed using many of the same materials as the houses, with a large hole on which a cooking pot was placed, and a smaller opening on the side into which the user added firewood to fuel the flame. These were built outside the houses and were of varying sizes for different purposes. Smaller ones cooked household meals while bigger ones were used to boil paddy before dehusking. Some families made businesses from boiling paddy for other households. While smoky, being outside meant the stoves had less of the obvious health impacts of firewood cooking in enclosed spaces, but they were far from the sleekly designed 'clean' cookstoves propagated by governments and NGOs (Khandelwal, et al., 2017).

Urjapur had been included in a number of clean cookstove programmes, joining the ubiquity of clean cookstove projects across rural Odisha and India (Khandelwal, et al., 2017). The bright yellow NGO-erected signboards on entry to the village explaining the cookstove projects were the only way to know this. Women, who did the overwhelming majority of the cooking, made no mention of the programmes unless asked. The cookstoves themselves were stored, unused, under beds, in cupboards or amongst piles of other belongings. It became a running joke between Jaya and Subhra that when I asked about them women would excavate unused corners of their houses to show them to me, brushing the cobwebs off them and explaining that they were of little use and that they really did not know why they had been given them. They were a source of bemusement and often accompanied with, "I don't know why we have these, maybe [the implementors] don't know we have our own stoves." There was no mention of the 'cleanness' of these stoves, and when asked about the smoke, women pointed out that their stoves were outside anyway. As one woman astutely

pointed out, “We have cleaner air in the forest than in the town, anyway, why do we need to worry?” A couple of the women I spoke to said they had tried to use the cookstoves during the rain, when cooking outside was difficult, but they said the hassle of making them work had not been worth it. Some women were embarrassed that they did not use them, but for the most part, there was greater confusion as to why anyone would think they would use them.

The households who were given powered cookstoves under TERI’s ‘Light a Billion Lives’ programme, were most confused. The idea was that the solar panel was attached to a small fan in the stove, which made for more efficient combustion of the wood inside. As was quickly pointed out, using them would involve cutting wood into small pieces to feed into them and they would be little use in cooking enough food to feed large extended families. It seemed ridiculous to most women who it was thought would use them. The stoves had been given out to women in the community seemingly at random, but those who had not been given them had little resentment, seeing little purpose in the devices. They were not seen as symbolic of government attention and had little value.

The decisions made by the community about how energy interventions in Urjapur were adopted, reengineered and rejected were logical. Development practitioners have often framed the failure of technology to ‘transform’ communities as a lack of behavioural change and a misuse of technology, often seeming to frame the users as uneducated, stubborn luddites (Crewe & Harrison, 1998). The reality in Urjapur seemed less that the community were wedded to their ‘traditions’, if they could be called that, but that they were constantly adapting and readapting to circumstance. The ‘failure’ of the solar projects could (and potentially should) be blamed on poor project design and the lack of flexibility in the minds of the project designers and implementors. Equally, however, it should also be acknowledged that the community were still participating in them and using localised innovation (or *jogad*) to appropriate what might be taken from them and to mitigate the practical risks presented by them in that context. Using the language proposed in critical institutionalism (de Koning, 2014), the responses to these energy projects could be described as some combination of alteration and articulation of the interventions; elements of the projects were reused or re-innovated, such as the street-lamp batteries, while others were rejected outright.

3.4 Conclusion

This chapter has provided an overview of the development landscape in the Urjapur community. Based on literature relating to conceptualisations of *jugaad,* it argues that the processes of *jogad* and appropriation were critical to understanding how individuals, households and groups across the community navigated development projects as a means to leverage sometimes unexpected opportunities and outcomes. These processes of appropriation have arguably often been left out of the analysis of many development processes. However, these contribute to an understanding that moves beyond the 'successes' or 'failures' of development projects and schemes, to provide an analysis of how they are made useful and appropriated by the communities they are implemented within. This moves away from linear notions of development, towards multi-layered, intersectional understandings of how development outcomes were shaped by the community themselves, often regardless of the intentions of external agents. This framing of how people interacted with development projects, by means of exercising agency over them, is critical in developing an understanding of such projects that decentres the focus from the agendas of the implementors. This provides an insight into how the original 'scripts' of such projects were challenged, subverted and appropriated towards what was most useful in the community.

I frame these processes as a version of *jogad*, which were central to life in a context with significant challenges and facing perceived marginalisation from the government. This utilises concepts of *jugaad* and *bricolage* to investigate the processes by which this appropriation took place. However, I also argue that these were different within groups across the community. For higher caste men, much of their interactions with the state and with NGOs were focused on maintaining control over opportunity and resources. The regular petitioning of the government on a number of issues as well as the control of spaces and interactions with external actors meant that they often acted as gatekeepers between the wider, and more marginalised community, and the high level external actors. They often had fewer reasons to *jogad* solutions for themselves and were more focused on leveraging relationships to fix the problems they saw.

Within these power structures, we see innovation and problem solving, as a form of *jogad,* often enacted as a form of subversion of, and sometimes resistance to, development interventions by lower caste and Adivasi groups, as well as women. These subversions and resistances were more subtle and understated than those of the higher caste groups and

were eminently more achievable with interventions which took place on individual or household level. Interventions which took place on a community-wide scale were susceptible to becoming part of the existing community structures, where lower caste and Adivasi groups could not exercise *jogad* within them.

In and of themselves, the conclusions from this chapter provide insight and understanding into how the Urjapur community engaged with development interventions, as well as an overview of the developmental landscape of the community, and some of the frustrations and challenges that different groups saw within it. This framing also provides a critical foundation from which to understand how the micro-grid was received in the community. The next chapter builds upon this, to explore the perspectives of those within the community in how they engaged with the project. The ideas of participation, appropriation and *jogad* proposed in this chapter and central to this.

4. The Micro-Grid in Urjapur

4.1 Introduction

Chapter 3 introduced the development landscape in Urjapur and explored the existing ways in which the community engaged with development interventions from the state and NGOs. It argued that many of these interventions were appropriated by the community and adapted to their own uses, needs and priorities. I explored this concept as being part of *jogad*, a process of 'making do' and innovating, but by which the fundamental meanings of these interventions were challenged and shifted. This chapter focuses on the micro-grid through a similar lens. It introduces the micro-grid and, using a number of ethnographic vignettes, deconstructs some of the meanings pulled from it and the negotiations around it, by both the engineers of the system and the Urjapur community.

This chapter, and the thesis as a whole, takes a critical approach to understanding the micro-grid. In some ways, I have attempted to deconstruct the micro-grid through a similar process to Akrich's 'de-scription' (Akrich, 1992). However, this deconstruction is based largely on the ways in which the community themselves were engaging with the micro-grid and how they were dismantling the wider assemblage around with it, including the ideologies, futures and values scripted into it. As with the wider development interventions in the community explored in chapter 3, there were varying responses to the micro-grid and people pulled meaning from it in numerous different ways. For some, the micro-grid was rejected outright, based on issues with the system itself, or what it represented. For others, the micro-grid was an opportunity, but not in the ways proposed by the engineers; it was something to be remodelled within the village context. Ultimately, it became grounds for negotiation, and a push and pull over who controlled it and who exercised agency within it. Critiques of the micro-grid were not uniform across the community, nor were the way in which people drew meaning and uses from the micro-grid. The ability to negotiate around the grid was not universal. A critical component of the critique and deconstruction not only centred on the micro-grid itself, but on how the micro-grid cast the community with relation to the state, to ideas of modernity and progress. As will be explored more in depth in chapters 4 and 5, the micro-grid constituted a relationship between the community and the implementors, but also reshaped other relationships, with many more intersecting actors.

This chapter is based on social construction of technology (SCOT) literature which moves away from solely technological or social determinism, instead engaging with how societies shape technology, but also the subsequent implications for how technologies shape communities and relationships (MacKenzie & Wajcman, 1999). It frames the micro-grid assemblage as constantly evolving and being disassembled and reassembled in a multitude of ways by a range of people (Grove & Pugh, 2015). I argue that the way in which people critiqued the grid, and actions they took in response to this, also stemmed from the practices of *jogad* in the community. There was a significant disconnect between the vision put forward by the engineers of the system (see introduction and this chapter) and the community and this became a constant point of contention. From this point, the technology was constantly being renegotiated, reshaped and remoulded (Sharma, 2020). This primarily stemmed from the community, but also involved the engineers in subsequent processes of reshaping their own approaches in response the tensions around it.

This chapter draws on conversations and events which took place over the course of the fieldwork period. The nature of my fieldwork meant that my engagements with the micro-grid and solar in conversations within the community were sometimes few and far between, and the quotes and vignettes in this chapter reflect that piecemeal nature. The conversations and events which I took part in sometimes intersected either directly or tangentially with the micro-grid, but very often had little relation to it. While there were points where the micro-grid was central to discussions and debates happening in the village, there were also times and a lot of people for whom the micro-grid was in the background, a small part of the complex fabric of people's lives. This is not to understate the importance of engagements with the micro-grid; it was a topic of discussion, debate and contention as well as a potential vehicle for change and opportunity in the village, as will be seen in this chapter. However, while it is central to this analysis, it was not necessarily continuously and overbearingly central to people's lives.

4.2 Scripting and De-scripting the Micro-grid

The SolarFuture micro-grid connected all but one of the 150 households in Urjapur. It provided alternating current (AC), allowing users to plug in generic AC appliances (as opposed to cheaper DC micro-grids, which put greater limitations on the types of appliances that can be used (Planas, et al., 2015)). The solar panels for the system generated 30kW of electricity and were situated in a field in the centre of the village, owned by Jaya's family. When

Figure 7: Urjapur micro-grid.

Anshuman, the founder and CEO of SolarFuture first introduced it to me, he said "We're bringing in technology to solve social issues." He repeatedly emphasised enterprise development and economically 'productive' uses of the micro-grid as central to how it would transform the village. The vision for the micro-grid that he proposed was almost futuristic, hi-tech and sophisticated, in a place often characterised as being the direct opposite. The visual imagery of the grid was striking (see figure 7), with glistening panels contrasting with the lush green of the surrounding forest and the *kutcha* roads through the village.

Next to the panels was a small control room, which housed the batteries for the system and the processing units for the 'smart' grid. In the village, only Mukesh had a key to this room. Outside each *sahi* was a locked box of smart meters, corresponding to the houses in the *sahi*. The smart metering was used to monitor local consumption of electricity from the grid, which Anshuman's team of engineers could track through a satellite data connection to enable a remote, cloud-based monitoring system and schedule the demand for the maximum efficiency in energy usage. The key component of the system was the provision of energy for industrial 'productive' loads, such as irrigation pumping, agricultural machinery, businesses and small-manufacturing units. These were central to how the micro-grid was intended to catalyse change across the community. The starting point was with energy management, but

Anshuman and his team of engineers had plans to monitor water, soil and air quality and control the community's responses to these, to enable future 'smart' agriculture and water usage. He saw potential for future e-governance, tele-medicines and tele-education.[12] His vision for the micro-grid was transformational; he anticipated change across the community, saying "We need to develop matrices so we can measure how it transforms the entire community".

Urjapur had been identified as the site for SolarFuture's first micro-grid by one of the directors of the state renewable energy agency (OREDA), who recommended it to Anshuman. People in the community had already been petitioning the forest office for grid access for some time, and OREDA had worked in partnership with the forest office to provide solar home light systems in the village some years earlier. While most of OREDA's operations[13] were based out of Bhubaneswar, they had a representative in the block office in Angul, who was occasionally mentioned with references to the micro-grid.

When Subhra and I first arrived in Urjapur, we asked a number of people about their impressions of the micro-grid. As the topic of my research, it seemed like the obvious way to start conversations and to understand how it was perceived. Households surveys and community meetings had been central to SolarFuture's engagement with the community (though they had engaged almost exclusively with men in the community). Numerous visitors, from media representatives to NGO workers and government officials, had been ferried into the village to visit the micro-grid, sometimes making cursory visits to households to ask a question or two about the micro-grid. Most people were clearly well used to being asked about the micro-grid and we received somewhat formulaic responses. At every house we visited people would say, "Before there was darkness and now, we have light", as if it was some kind of mantra attached to the solar energy. Further questioning about what people used it for and how they felt about the pricing structure would often be met with a shrug and a vague gesture towards a newly installed LED bulb. Access to electricity for lighting was

[12] It should be acknowledged that some aspects the wide reaching promises for the micro-grid were never realised, at least during my fieldwork. For instance, the BBC article mentioned in the introduction highlighted a mobile app that micro-grid users could use to connect with the 'smart' system, which, in reality, did not exist.

[13] I go into more detail on OREDA's engagements with off-grid energy projects in Odisha in chapter 6, including interviews and visits which I undertook through them at points during my fieldwork. Chapter 6 looks at the wider landscape of solar in the state, but builds on some of the ideas proposed in this chapter.

clearly of fundamental importance. However, beyond this, the responses did not seem to live up to the fantastical imaginaries of the 'smart' rural future that was proposed by SolarFuture.

I was unsure where exactly these responses were coming from. I was well aware that, as a foreign newcomer, I should expect people to be somewhat cautious about sharing their opinions, but the responses seemed decidedly underwhelming. Even if the micro-grid did receive such universally positive reviews in the community, it seemed far from the transformational vision that had been put forward in its conception, that which had captured the imaginations of the writers of the BBC article and the numerous other types of coverage and awards it had received. The charisma of the micro-grid which had propelled it outside the community seemed to have little impact inside it. I wondered at first whether the system had been accepted in the community to the extent that it had become 'part of the furniture' (Gupta, 2015); unremarkable, but effective. Over time, as I became more familiar with and in the village, many of these conversations changed, particularly in more informal discussions. More assertive opinions came to light and it was clear the narratives around the micro-grid were considerably more complex.

There were ongoing negotiations and renegotiations about the pricing of the system. Ravi was quick to point out that it cost more than the traditional grid did, but Jaya explained why this was and how it was organised.

> *There's a committee for the solar, which has a representative from every sahi. The committee organises the payment for the system, but it was only organised last month what everyone should pay. People are happy to pay though, because it means that we can save up to replace the batteries in 5 years' time. It's more than we had to contribute to the OREDA systems and more than we spent on kerosene, but it's okay because we can use it for more things.*

The prices changed numerous times during the time I was there. They were renegotiated constantly between Ravi, Jaya and SolarFuture, with Mukesh (who was employed to maintain the system) acting as a go-between. At the beginning of fieldwork domestic loads paid a connection charge of Rs 500 (approx. £5), followed by a price of Rs 20/unit (KWh) of electricity. So called "industrial" loads, those which counted as economically "productive" uses of energy for small businesses, paid a connection charge of Rs 2000 (approx. £20) and a subsequent charge of Rs 7/unit. This was not an insignificant sum of money for anyone in the community, and poorer families often said the prices were prohibitively expensive. The

OREDA (government supplied) home light system they compared it to had come with a nominal monthly charge of Rs 20/month per household, but which was rarely collected. There were only two industrial loads; Jaya's shop, where the solar electricity powered a small fridge and the ecolodge, which used the solar to supplement its own solar array, which had been damaged in a lightning strike a few months earlier.

There were frustrations about the number of hours in which the day the micro-grid was available. These were also often compared to the main grid. "Mostly we're happy, it's just that there isn't enough power for more industries and agricultural uses. And the domestic loads are limited from midday until 4am and the industrial loads from 9am to 9pm.", Ravi said. The timings of the electricity provision would also change incrementally over the period I was there, but the sense of rationing of electricity from the micro-grid was a ongoing.

Alongside these, there were smaller, more isolated disputes. The one household who had not been connected were angered by this decision; Mamali's family, introduced in chapter 2. They were Adivasi family and had given government land on which they could live and farm, but which was on the outskirts of the village and right in the path of elephants and other animals moving through the area. They said they needed the micro-grid connection to light the outside of the house to scare the elephants away. Without it, they had to set a fire outside their gate each evening to try to protect their property. SolarFuture said they had not connected it because it was economically unviable to extend the connection so far. They said the local government should pay for it. Jaya's family were also in conflict with the SolarFuture, over tensions about whether they had been paid for the land that the solar panels were installed on. They said they had not received payment and so should get electricity free, whereas SolarFuture said they had been paid fairly. It was never clear what had actually happened.

These contentions around the micro-grid were not insignificant, but, at least at first, seemed fairly superficial; they related to the technical workings and design of the system and could presumably be remedied by alterations to the operating structures and through ongoing dialogue between the engineers and the community. They were 'kinks' in the system to be ironed out, reminiscent of literature exploring the practical and technical challenges in implementing micro-grids more widely (Bhattacharyya & Palit, 2014; Palit & Sarangi, 2013).

Before long, however, it became clear that these contentions were much more deeply rooted in the design and development logic which had been 'scripted' into the system. They were

issues which became much more significant when viewed within the wider multiplicity of meanings and affordances taken from the micro-grid, which related to structures, relationships and values that went beyond the physical technology or its operational structures. These coalesced from multiple different subjectivities across the village to render the micro-grid assemblage as something vastly contended and under a constant process of being deconstructed and reformed. This was initially laid bare in a conversation with two of Ravi's cousins, Biswa and Param, at their house in Gopal Sahi.

Biswa and Param were showing us their rice huller while we were talking. It was diesel powered and they had bought it, along with an auto rickshaw, when they sold their family's cattle herd several years earlier. They now ran the rice huller as a business, processing one can of paddy for Rs 10 if they got to keep the husks as cattle feed and Rs 20 if they did not. Families who could not afford to pay did farm work for them instead. I asked if they had considered converting the huller's current diesel motor to an electric one, so they could run it off the micro-grid. This prompted a tirade about the micro-grid, the government and the injustices they felt. I was fairly used to these about the government, having heard similar accounts from many of the higher caste Hindu men in the village (but rarely heard the same from Adivasi men or women), but hearing such a passionate response to the micro-grid was new.

"It's even more expensive than the [traditional] grid!" Biswa said "We don't get roads, electricity, healthcare or schools, all because the government is corrupt. The politicians will promise everything and then do nothing. The solar is more expensive than the grid and there isn't enough of it. We need to have it all day, not just in the evening. Simulia gets grid for Rs 2 per unit. If they want us to use the solar then we should be getting a subsidy for it."

I asked if the price was the main problem with the micro-grid.

Biswa answered "No, we could afford it, but it's unfair, we should have access to the grid. Nothing here works, the teacher doesn't come to work in the school, the road gets flooded every year, the water pump broke 3 weeks ago and no one has come to fix it."

Param joined in "They call it a smart village? We don't even have a road!". The English word "smart" was used with a sense of sarcasm and irony. Everyone laughed, but the point he made was serious, "It's just a title that they use to take credit for it, they are only interested in themselves."

“Would you rather be relocated to outside the forest, like the forest office is proposing for Karada?” I asked. I referred to the often-discussed relocation plans the forest office had for villages inside the core forest area, supposedly to enable the translocation of tigers from Madhya Pradesh in efforts to repopulate the reserve. Karada was the next village on further inside the forest and was even more disconnected. Param grimaced, “Now we’ve got the solar they wouldn’t relocate us, even we wanted to.”

Their family ran most of the village committees and their cousin was the village president. They were comparatively wealthy and controlled many of the key resources in the community, including the rice huller and auto rickshaw. They were some of the harshest and most vocal critics of micro-grid, challenging not just issues with the system, but what it fundamentally represented. They saw the micro-grid as poor compensation for the short comings in resource provision for the community. Their views on the micro-grid were illustrative of the state neglect and marginalisation they felt, but beyond this, they saw the micro-grid as symbolic of that neglect and indicative of the lack of care the state gave them (Aklin, et al., 2018). The ‘smart’ future that SolarFuture were offering was laughable and almost insulting when compared to the rights and facilities that they felt they were entitled to from the state. Far from offering them a means to undermine state control, the micro-grid was an affront to the wish to be recognised, catered to and respected by the state. As is explored in the next chapter, Biswa and Param, along with Ravi, were members of the community who regularly petitioned the block offices for greater provision of resources. They routinely contacted the forest office to ask for a wall to be built round the community to keep the animals out. They had also participated in protests across the reserve, demanding greater state provisions and fewer controls from the forest office. The micro-grid became part of their negotiations with the state and the forest and they were reluctant to be forced to appeal to a non-state actor in accessing what they felt they were entitled to. There were elements of technological determinism in their view of the micro-grid, not in the sense of the technological ‘fix’ as proposed by Anshuman, but in terms of the role in which the micro-grid cast them in (Sharma, 2020). Where they were appealing to the state to be given electricity as citizens, the micro-grid was forcing them to appeal to a private sector actor as beneficiaries or even customers.

Their response to the micro-grid was, by and large, limited to the higher caste men in the community; few others mentioned the micro-grid explicitly with relation to the government,

though comparisons with the quality and price of main grid were more common. Biswa and Param were in the relatively privileged position of being able to 'reject' the micro-grid outright, choosing instead to maintain their efforts to petition the government for the main grid, with regular visits to the Block Development Office (BDO).[14] They still used electricity from it in their homes for lighting, but did not use it to power any machinery and had no plans to make any investments in it. Even on a pragmatic level, the fact that they could afford to continue to buy diesel to keep their rice huller running without depending on SolarFuture or the micro-grid electricity gave them a level of autonomy that others in the community could not necessarily afford.

4.3 Reassembling the Micro-grid

Biswa and Param were not alone in critiquing the micro-grid. Others in the community rejected the micro-grid on different grounds, for instance, in protest over its cost. The handful of families who had solar lanterns and solar home systems from previous energy projects that still worked occasionally used these to resist having to pay for the micro-grid. One woman from Gopal Sahi, Bhavana, was unhappy about the price of the micro-grid and was refusing to use it. She said that she couldn't afford it and so their connection had been cut off: "The minimum price is Rs 50 per month, they said. We can't afford that. We have another lamp we use anyway; we'll just use that instead. The other solar was given for free, why should we pay for this one? We can still get kerosene." She showed us a TERI lantern they had been given years before; though most in the village had broken, there were a handful still working.

Not all the critiques of the micro-grid were quite so explicit in their rejection of it. For some, the micro-grid was exciting. It was still seen as secondary to grid access (particularly in terms of the price and the lack of 24-hour availability), but there were many people who were willing to engage with the potential offerings of the micro-grid. It was notable, though possibly counterintuitive, that it often was Adivasi households and groups and individual women who were more amenable the engaging with it. They were arguably those who were most acutely and historically impacted by marginalisation from the state (Shah, et al., 2017), and from discrimination within the village itself. However, by and large, they did not seem to be affronted by the micro-grid in the same way that higher caste men were. That said, the

[14] See conclusion; after the end of fieldwork, this was ultimately realised.

ways in which they were willing to engage were often in contrast to the 'smart' vision put forward by SolarFuture. In conversation with women from different groups in the village, there was a sense of a wider potential in the opportunities the micro-grid provided and an excitement about what might come of it.

Lakshmi, a woman from an Adivasi family in Bandha Sahi, described what she might do with the new electricity available. "I'm excited that I could get a fridge and a fan and a TV, but I can't afford them now." I asked her when and how she might them afford them in future, and she said, "When my son is older, he can go out and work and bring back money." I asked her how old he was and she answered that he was eight. She laughed, admitting it would be a long time before she could think about those things.

Some households had already invested in TVs, and these had become places for communal gathering (as observed in a different context by Winther, 2008), with groups of women from the neighbourhood meeting to watch Odia serials. While they centred around neighbourhood groups, there was, perhaps surprisingly, no discernible caste based segregation on who could watch the TV, creating more integrated spaces than might otherwise have existed. The use of the micro-grid for TVs was dependent on when the micro-grid was switched on for domestic usage; primarily it was reserved for industrial loads during the day. It was also somewhat dismissed by the engineers; when I asked one engineer why women had not been included in the village meetings when the micro-grid was installed, he said "Why would we ask the women? All they use the electricity for is to watch [TV serials]." This dismissal was indicative of the wider attitudes towards women throughout the micro-grid assemblage (explored in greater detail in chapter 8), but also served to highlight the dissonances in what the micro-grid was for. Where some women cited the increased access to TV, phones and radio as making them feel connected to the wider world (Jensen & Oster, 2001; Standal, 2018), this was largely not catered for in the micro-grid design.

Numerous women also spoke of the micro-grid in terms of longer-term potential. This often revolved around the uses of the micro-grid within generational shifts and long-term aspirations. Given the levels of poverty in the community, any ideas of buying additional appliances to use on the micro-grid were contingent on future economic prosperity. Critically, none seemed to see the potential for the micro-grid to bring that prosperity, in contrast to Anshuman's vision. As explored in chapter 8, few, if any, of SolarFuture's attempts to engage with the community had included women. I asked several women, if they would

consider starting businesses using the energy from the micro-grid, in line with the expectations of the designers of the grid. Few women had any plans to do this. Some expressed interest, but most pointed to the failed SHG projects and the debt they consequently owed as well as the risk that came along with starting a business. Lack of access to training and skills, finance and access to markets were all mentioned at different points as to why setting up businesses was too challenging. Lack of electricity rarely seemed to be the problem, though had been framed as the 'technologised' solution (Abdelnour & Saeed, 2014). This, however, did not mean that women were not engaging with the micro-grid.

For non-Adivasi women in the community, for whom marriage revolved more strictly around a patrilocal structure that included dowries (Mitra, 2008), the micro-grid was appropriated into discussions around arranged marriages, status and future planning. During a conversation with a group of higher caste women, the topic of the micro-grid and marriage came up. One woman, Sangeeta, spoke of the micro-grid, saying "It's good, we can buy a TV and a fridge and things and then we will be able to get a better bride for our son. We're building a *pucca* house too, so a woman would want to live here." In response, her sister-in-law, Pratima, said, laughing, "We'll get those things as part of the dowry! Then we can use the grid to run them and we can enjoy them." The micro-grid, and the appliances that went along with it were already starting to shift aspirations and future planning, but in a way that fitted within the existing social structures and day-to-day lives, arguably through a process of domestication of the technology (Lie & Sørensen, 1996). These conversations did not go unnoticed by Santosh, the operations manager who worked closely with Anshuman, and was one of the more socially aware engineers. After a similar conversation with a man in the community, keen to leverage the micro-grid for the purposes of dowry, he asked me nervously near the end of fieldwork if this constituted an unintended 'negative' impact of the micro-grid, in reinforcing what he saw as a socially regressive norm. He wondered what, if anything, they should be attempting to do about it.

These exchanges demonstrated a number of things in how groups within the community responded to the micro-grid. For many, it was not dismissed out of hand, but was associated with more incremental changes to existing lives in the village, as opposed to the transformational views of the community at large. People still made plans around the micro-grid, but these plans were not to make Urjapur a hive of economically productive activity. Instead, plans were made to appropriate opportunities from the micro-grid into existing

lifestyles, practices and structures of the community. The everyday ways in which women in the community, from various caste and tribal backgrounds, engaged with the micro-grid could be characterised by somewhat undramatic, 'mundane' energy applications (Groves, et al., 2017), in contrast to the more dynamic and aggressive changes envisaged by the implementors and the combative politics envisaged by the community elites. These 'mundane' usages relate more to relationships and identities, where energy was much more centred on conspicuous consumption, kinship networks and attachments (Wilhite, 2008). In contrast to what the engineers designated as 'productive' energy uses, aspirations to use energy within reproductive and care work were more common (Standal & Winther, 2016). Women mentioned wanting the use the micro-grid to run fans to keep their children cool, for example. In many ways, what these women were speaking about seemed much more grounded in the existing lives in the village than the alternatives imagined by the engineers, but there was also a dissonance in the temporalities that these changes were associated with.

The envisaged uses of the micro-grid with respect to dowry arrangements (Standal, 2018) or generational shifts indicated a longer term engagement with the system; one which would stretch over several decades. By contrast, the micro-grid had a enscribed maximum lifespan of 20 years. This lifespan was dictated by certain technical components in the system, but also depended on financial models where payments from the community were expected to the fund the replacement and upgrades of other components, including the batteries. The payments from the community were in a constant state of renegotiation, with many reluctant or struggling to pay at all. Even if the financial model worked to maintain the technical functioning of the system 10 or 15 years down the line, there was still an uncomfortable incongruity in how long term futures were envisaged around them micro-grid and how they were, or were not, technically designed.

The imaginings around the micro-grid were, in effect, dismantling and deconstructing the initial plans of the project. Women dismissed the idea of using the micro-grid to start businesses, because it did not make sense for them; the logic of electricity in the community kick-starting a thriving local economy was, quite simply, flawed. Instead, they assembled alternative uses and pulled on different meanings and affordances offered by the technology, whether or not these were 'condoned' by the engineers. To me, this evoked similar concepts to those *jogad* processes that had defined engagements with other development projects. The realities of using the micro-grid to watch TV were limited by the hours it was available

(except, of course, in the aftermath of the control box fire) and only time would tell whether the families did end up buying the items they dreamt of to improve their marriage prospects, but they were a means of appropriating agency over the micro-grid and embracing the opportunities that this presented. However, it was not just how people thought about the micro-grid that reshaped it. There were also more practical and realisable ways in which the community appropriated opportunity from the micro-grid, which went beyond the ways in which they used the energy itself.

When Anshuman and the SolarFuture team initially went to Urjapur, they had been keen (at least in theory) to 'embed' the micro-grid in the community (McLaughlin, et al., 2002), in line with wider movements within the off-grid energy sector (Ulsrud, et al., 2011). Local cooperation was seen as central to a long term sustainable system. From his perspective, this had taken numerous different forms, including community meetings and house visits. The 'smart' components of the micro-grid were primarily seen as critical to facilitate easier maintenance of the system. Issues around maintenance are a notorious problem for micro-grids (Palit & Chaurey, 2011), where their remote installation and perceived lack of local skills to fix such systems leads to many being left in disrepair. The 'smart' system was proposed to provide continuous monitoring of the system health and to alert its operators to any problems. However, there was still a need to have local people trained to undertake basic maintenance and cleaning of the system.

> *We selected seven capable men from across the community to train. They were taken to [the university campus] in Berhampur for a week to learn basic skills in electronics and maintenance. Then they could be responsible for the things that need fixed in the village, before one of our engineers can get there.*

These men were chosen from across the village, based on their 'capability'. One of them was Mukesh, who was chosen, he said, because he had worked on the OREDA project previously and so had some experience. In itself the selection of men had caused tensions in the village, particularly with the higher caste families who did not have family members chosen. Anshuman was adamant that he had not wished to cause controversy, but had just wanted a "meritocracy" in the village. No women had been considered for the role. Within a year of the micro-grid being installed, of the seven men originally selected and trained by SolarFuture, only Mukesh remained. The rest had left the village. Most had gone to Mumbai and Kolkata where they had found higher paying jobs using the skills they were taught by

SolarFuture. Two had even opened an electronics shop in Mumbai. They joined the sizeable number of men who left the village to work outside and send remittances back (Mosse, et al., 2002). For the most part the migration of these men was regarded as unremarkable by the families who were left behind. It was a boon in the sense that their more skilled jobs allowed them to send back higher remittances.

Their absence was not without resentment, however, which manifested as another critique of SolarFuture and their operation in Urjapur. The mother of one of the men who had left said, "If they hadn't trained him, he would still live here, instead he's the outside. They should have paid him more to stay in the village and run the grid." The men trained as technicians had been paid Rs 3-4,000 over the period of installation, which was a significant amount for any family in the village. Once they had finished, however, the salary proposed by SolarFuture had decreased, despite SolarFuture's anticipation that their contribution to the grid functioning would be ongoing.

The design for the maintenance of the micro-grid was seen as critical to its success but the way in which it evolved was unanticipated. It was reminiscent of the ways in which government schemes had been turned on their heads in order to maximise the gains to be made from them, in terms of a *jogad*-like way of approaching the situation. For the men who left the village after being trained, the micro-grid presented an opportunity to gain skills of significantly more use outside the village, where there was a market to use them. Somewhat ironically, their appropriation of the skills offered to them through the micro-grid fell somewhat in line with the enterprise-based development set proposed by SolarFuture themselves, though significantly more displaced geographically. However, their migration from the village ultimately undermined the functioning of the grid itself. This was indicative of the ways in which the structures and opportunities presented by the grid were appropriated by the community to fit their priorities, but also indicative of the unintended consequences of the design decisions. The micro-grid was left more vulnerable, more likely to break down and, ultimately, more likely to fail.

Anshuman also said that Mukesh had faced discrimination in his role, largely based on him being Adivasi. Higher caste families apparently refused to let him into their homes to fix connections and there were apparently attempts to intimidate him into waiving their payments. This was not corroborated by Mukesh himself, who was always extremely diplomatic in his conversations with Subhra and me, and usually avoided any difficult

questions by cracking jokes instead. Mukesh always emphasised the positive aspects of his role, which he saw as having given him new opportunities and sources of income within the community which he would not otherwise have had. However, as much as Anshuman wished for a 'meritocracy' in how the micro-grid was maintained, if was difficult to separate this from the structures of the community.

4.4 Negotiating the Micro-grid

The perceived opportunities from and critiques around the micro-grid resulted in inevitable contradictions and contentions, both within the community and between the community and the engineers. While many of these were limited to conversations and discussions, others resulted in ongoing negotiations and manoeuvrings around the micro-grid. This was caused, at least in part, by the 'smart' component of the micro-grid system. The constant monitoring meant that SolarFuture and its engineers were constantly tethered to the community. A critique of the off-grid energy sector which I heard frequently was the tendency for solar PV technologies to be 'dumped' in communities and left without future maintenance (Palit, 2013), resulting in the graveyard of solar lanterns described in the previous chapter. Far from the development interventions explored in the previous chapter, this 'smart' connection meant that the micro-grid system could never be entirely appropriated by the community. Instead, the engineers had a proximity not just to the technology, but to how it was used. They were constant actors in the micro-grid assemblage and arguably also partook in the ongoing processes of disassembly and reassembly.

Every time a SolarFuture engineer visited Urjapur, there would be an inevitable renegotiation session around a table in the ecolodge, where Ravi and Jaya would negotiate (claiming to be on behalf of the community) for new prices, connections and scheduling arrangements. The engineers would respond in attempts to both protect their own interests and to appease the demands. These negotiations around the payments and scheduling of the grid could also be interpreted as renegotiations of the relationships around the grid, particularly in terms of the control and power between SolarFuture and the community. Where tensions arose outside of these visits, Mukesh would have to relay messages from the community about their concerns with the grid to Anshuman and Santosh, who would attempt to choreograph a response from a distance. These negotiations meant that the micro-grid was far from stagnant. While the physical technology, for the most part, stayed the same, the structures and processes around it were constantly shifting and evolving, shaped by both the

community and their engagement with it and the engineers and their responses to the changing critiques and meanings drawn from it. This demonstrated an instability in the micro-grid assemblage (Bijker & Law, 1992), which seemed increasingly fragile and precarious.

There were two moments which most characterised this for me, which are recounted below. In conversation first with people in the community and secondly with Anshuman and Santosh, the idea of new solar home light systems, proposed by the local OREDA representative, were considered. At first, I did not realise both conversations were talking about the same systems, as they illustrated the vast divergence in how people within the community and the engineers viewed the system and the different meanings and affordances they were drawing from it. The conversations demonstrated the extent to which the micro-grid was being constantly remoulded and reformed, and something which changed relationships and the appropriation of agency in the community. They also drew in engagements with actors outside of the community and engineers, widening the negotiations around the grid to a larger ecosystem, which is built upon more in the next chapter.

The first conversation took place in mid-June. We spent most of the day in one of the houses in Gaon Sahi. The ecolodge had no guests, so Mukesh and Jaya came with us. Summer was in full force and there was a general feeling of irritability and discontent (myself and Subhra included), understandable at 48 degrees and only heightened by the fact that the micro-grid only got switched on for households in the evening so there was no electricity to run a fan. We had talked at length with the owner of the house, Manoj. Jaya said his family were some of the poorest in the village and struggled to take on the financial burden of caring for his niece, who had sickle cell disease and needed frequent trips to Cuttack needed for treatment. The whole family chipped in, but Manoj said it was difficult; they did not own their land, so they worked labourers on other people's, but income was unpredictable. I asked Manoj about the micro-grid.

"I use it for lighting and I have a fan. It's good, but expensive."

"How much do you pay?"

"Last month the bill was Rs 175, I paid Rs 50. I couldn't afford it all."

It was understandable that paying for solar energy was low on the list of priorities for Manoj. I had heard several people quote the price of their bill differently to the price they actually

paid. I asked Mukesh why that was, given that he was the one that collected the money for SolarFuture.

“Some people don’t pay their whole bill, but as long as they pay the minimum Rs 50 they don’t get it shut off.”

“How many people have you shut off so far?”

Though the grid had been installed for over a year, SolarFuture had only recently managed to negotiate payment for it.

“19 families so far, who didn’t pay anything.” Mukesh said.

“Do they not pay because they don’t have the money or because they don’t want to?”

Mukesh diplomatically assured us that it was only because people did not have the money that they didn’t pay and that no one would choose not to pay. He often adopted the role of peacekeeper between SolarFuture and the community and was keen to portray both SolarFuture and the community in a positive light, to each other as well as to me.

But Manoj interrupted. “Some people don’t want to pay. They think the solar is too expensive. They can use the other systems for lights and everyone can use kerosene if it comes to it.” He got up and showed us the OREDA home light system installed on the thatched roof of his house and connected to a single lightbulb and a phone charging point inside. It looked worse for wear, with worn cables, broken switches and a dusty solar panel. From what Jaya had said, the systems were not more than a few years old, but clearly had not been designed for long term use in the hot forest landscape.

Jaya joined in, “Everyone thinks the solar should be free, like the other solar we’ve had, why should we have to pay so much for this one? If [SolarFuture] want people to pay, they would need to take away the old OREDA solar systems.”

When I had first arrived, everyone was polite and positive about the micro-grid, presumably giving me responses they expected I wanted to hear. As I was there longer, either their discontentment grew, or they stopped pretending to get along with the micro-grid for my benefit.

I asked Mukesh if everyone in the community knew why they were paying for the system.

"We've been told it's for the maintenance of the solar, but not everyone understands, they think they should still get it on subsidy, like rice and kerosene." Every household in the community qualified as 'below poverty line' (BPL)[15] and so received vastly subsidised rations of rice and kerosene, which for many were fundamental to survival.

Jaya continued, "They should have the micro-grid just for businesses. People could use it to run enterprises, but people shouldn't have to pay for it for household use because it's not helping them make any money. Even then the charges for businesses are too high. I pay Rs 500 for the electricity for the shop, but I only make Rs 100 a day so it's too much." Jaya used the micro-grid to power her *kirana* shop, the only one in the village. She used the electricity to run a fridge, from which she sold cold drinks and milk.

"If the micro-grid should only be for businesses then what would people use at home?" Subhra asked.

"There are rumours the OREDA will offer new home solar systems with a fan, a LED strip light and phone charging in every house. We want to ask for those. Ravi and I will go to the block office and try to get them."

"But most of the OREDA ones broke before, didn't they?" I asked

"But the government will give us them for free. The micro-grid can still be for businesses, but they will have to bring the prices down."

"When will they be installed?"

"As soon as we can petition the block office in Angul to get them."

I left the conversation feeling uncomfortable. Both in what she was saying and in the hushed tones they were said, it felt almost like Jaya was planning some kind of mutiny against the micro-grid. The frustration with the system had escalated to point where they were actively seeking other options to meet their energy needs. I could only imagine the frustration of SolarFuture when they found out about the new systems. As Jaya had said, more solar in the community would only make people less likely to pay for the micro-grid and, as Mukesh had indicated, the financial model for the system depended on people paying so that the system

[15] 'Below poverty line' is an important categorisation (along with ST, SC and OBC caste reservation categories) that dictates access to government schemes in India. The categorisation has been critiqued, as the 'poverty line' is somewhat arbitrary and often households who are document-poor often get left off the registers to access BPL cards (Drèze & Khera, 2010; Fernandez, 2010).

could be maintained. If people did not pay, presumably eventually the funding to fix breakdowns or fires would dry up and the system be abandoned. I had no vested interested in the micro-grid continuing to function and I could understand where Jaya was coming from. However, it seemed incredibly wasteful for all the time, resources and huge amounts of money that had pumped into the project, along with the hopes and aims that had been put into, to come to nothing.

Around five months after the initial conversation with Jaya, Mukesh and Manoj, I met Anshuman and Santosh in the SolarFuture office in Bhubaneswar. They were both based in Bangalore but made visits to Odisha for updates on the micro-grid in Urjapur and to explore potential opportunities for other micro-grids in the region. They seemed to have an endless stream of meetings with government officers, elected officials and companies all over eastern India. There was clearly a significant appetite for the technology they were proposing. I sometimes met them when they were in Bhubaneswar to ask any questions that I had for them about the micro-grid and its implementation. Given their own distance from the micro-grid, they were also keen to get my feedback on what I felt about the grid. I had not felt it was my place to tell Anshuman and Santosh about the conversation with Manoj, Jaya and Mukesh. As the months had gone by, it had not been mentioned again to me in Urjapur. When I arrived that day, however, things in the SolarFuture office were busier than usual and Anshuman and Santosh were clearly stressed.

They were talking about a man named Charan, who was the OREDA representative in the BDO in Angul (the one the Jaya and Ravi visited regularly to petition for resources and programmes in Urjapur). He worked closely with the Gram Panchayat representatives and the Forest office, but was not well liked by the community or those in SolarFuture. I had tried to contact him early on in fieldwork to interview him, since he had been involved in the micro-grid from an early stage. He had always been absent from the office and had never returned my calls. However, I was told that he did visit Urjapur one evening while I was not there to ask about what I was doing in the village and what questions I was asking. The women who spoke to him found it amusing, and told me that they had given him a detailed list of all the food they had introduced me to while I was in the community and he had quickly become bored. However, after that point I was cautious of him and what his interests might be.

“He was supportive of the micro-grid at first. It was coming from his own superiors at the OREDA office in Bhubaneswar. He helped to organise the meeting with the community and gave us logistical support for the engineers and technicians installing it.”, Santosh said.

“He thought if he helped us, he would get a cut. We never paid anything to him, we don’t do that.” Anshuman said, “But he was unhappy about it and as we put more money into the micro-grid, he got more and more unhappy. Now he’s trying to persuade the community to get the OREDA system instead.”

This was, I eventually surmised, the same OREDA system that Jaya had referred to. I had seen it installed in other communities I had visited, where people were largely unimpressed with components of it that had broken.

I asked why Charan would want to do that.

“There’s new funding every 5 years to install new solar systems. If it’s installed with government money, he would get a cut and he would get it every 5 years when they replace them. He won’t get that from us, because we’re planning for the micro-grid to be there for 20 years.”

I had heard similar stories elsewhere. Government department sending out tenders for projects to be taken up by contractors would expect certain favours in exchange for the deal (Shah, 2010, pp. 66-88). The bidding for the project would, unofficially, allot a portion of the allocated funds to ensure everything went smoothly along the way. The head of one company applying for government tenders for energy projects went as far as telling me which government officials preferred to receive iPhones and other gifts in exchange for contracts. Government employees down the chain would also expect a cut to help with installation. Charan was clearly angry that this had been overlooked by SolarFuture, who were keen for their operations to remain uncorrupted. Santosh expanded on how Charan went about this.

“Mukesh told us that some of the contractors for the solar home systems have been telling people in Urjapur that they should break our system and, while we repair it, they will install the solar home systems and then they’ll get both free of charge.” He said.

“Charan has also been telling people in Urjapur that the block office will subsidise the cost of the micro-grid. We wouldn’t mind if they did, but we don’t think it could happen. We’ve had

problems with him before, but we can't rock the boat if we want to keep working in the area." Anshuman added.

They implied that they thought Charan was also lying to the community. I assumed that people in Urjapur would be cautious in believing what he said, but I was also aware that many were keen for some kind of subsidy with respect to the micro-grid, and I wondered how much Charan was playing into this.

"What will you do?" I asked.

"We haven't said anything to Charan. But we're trying to put more effort into getting micro-enterprises started in the community. We wanted your help with suggesting how to do that. If people are using the micro-grid for more productive uses, they might see more value in it. They'll also have more money to pay for it with."

They went on to discuss the potential micro-industries they could set up there, discussing how to develop market linkages, train people and provide investment opportunities.

This conversation took place shortly before I was due to leave Odisha and, at the point that my fieldwork ended, the issue was ongoing. I never found out if the OREDA systems were installed and if this changed how the community related to the micro-grid. But the two conversations highlighted the politicised nature of the solar micro-grid and of energy provision in the area, where the intersected interests of different groups coalesced around a single technical intervention. By and large, they were speaking about the same issue; the potential for solar home systems to be installed in the community in addition to the micro-grid. But they were starkly different; so different in fact, that I did not immediately recognise that they were talking about the same OREDA solar home systems. The narratives presenting in these discussions were radically different for everyone involved.

For Anshuman and Santosh, the proposed solar home systems were a risk to the micro-grid, which both threatened to undermine its sustainability and were indicative of the lack of the community buy-in to the system. To them, the micro-grid was precarious and in need of protection to ensure the delicate balance around it was maintained. Their responses to this perceived threat, which would have vastly changed the nature of the micro-grid, was to change course and readapt their own responses. While they had created the original 'script' for the micro-grid, they were also attempting to reassert a control over it. Their question to me in how they could readapt the system was arguably their own process of *jogad*. They

were looking to other opportunities they could mobilise and adapt their own operation to ensure that the project was successful. Their proposals for developing more micro-enterprise was very much in keeping with how the viewed the potential of the system, but their attempts to make it more useful could have been beneficial within the community. However, their campaign to make the micro-grid 'work' above all else, potentially ignored the question of if the technology was actually helpful, and if so, in what ways and for who in the community?

For Jaya, the OREDA solar home systems represented an opportunity to leverage control over the micro-grid, forcing SolarFuture to reduce their prices to compete with free newer systems. She had both a vested interested in reduced prices for solar for her own business, as well as concern over how the prices impacted people across the community. The solar home systems presented an opportunity to appropriate agency over the micro-grid and a way to remould it to suit the needs of the community; both central components to types of *jogad* proposed in this thesis. The new systems could decrease the money required, but also the dependency on SolarFuture for lighting, fans and phone charging; for most the entirety of household energy usage. This was a way to re-endow a form of agency and control over household electricity supply back to the community. She was not unwilling to utilise and engage with the micro-grid, but she seemed adamant that it should be done on the terms of those in the community.

For Manoj, alternatives to the micro-grid were a means to access lighting and electricity without high pricing, particularly at a time when his own family had other financial responsibilities which were difficult to manage. This provided a pragmatic way to 'make do' within the means he had available to him. His reference to using kerosene rations for lighting if it came to it indicated priorities which were far from the transformational visions of development proposed by the micro-grid, and instead focused on a more urgent need to 'get by'. His struggle to pay the monthly bills for the micro-grid energy highlighted dissonances within the 'scripting' of the system. Manoj's unpredictable income stream, with unexpected outgoings and little security net, meant that regularised monthly payments were simply unfeasible. This was not unique to him, as he said that across the village, many families had been struggling to pay.

I never spoke directly with Charan, but it seemed that he saw the micro-grid as something which had disrupted a *status quo*. Both financially, and presumably professionally, the

existing model of installing solar home systems, which broke and were replaced five years down the line, worked well for him and for his contractors. There had been a micro-economy around solar (albeit generating both corruption and electronic waste (Cross & Murray, 2018; Kumar & Turner, 2020)) that was well established and had functioned and served him well. The micro-grid in this sense was conforming and 'cleansing' both in terms of corruption and waste, but it disrupted his operation. His efforts to try to undermine this, at least as recounted by Anshuman and Santosh, also seemed to be an attempt to re-exert control over off-grid electrification in the village. His methods were significantly more problematic and underhand, but resonated with attempts made by others in the system to remould and readapt the assemblage around the micro-grid.

4.5 Conclusion

This chapter has proposed the conceptualisation of the micro-grid as an assemblage of ideologies, aspirations, relationships, technologies, opportunities and social structures. This framing is valuable in exploring many of the responses to the micro-grid in Urjapur, and in understanding what this means for how the micro-grid evolved and was shaped over time. The assemblage framework facilitates an ability to view the micro-grid as a shifting entity that was subject to pushes and pulls in the negotiations around it. Building on the ideas of appropriation and *jogad* put forward in the previous chapter, this chapter primarily looked at the ways in which the system was critiqued and deconstructed both practically and discursively. Ultimately this resulted in dissonances between the numerous ways in which the system was perceived, many of which were at odds to the original intentions of the designers. Using theory from SCOT literature (MacKenzie & Wajcman, 1999), this can be explored through the lens of the 'scripting' of the project by its designers (Akrich, 1992), and the subsequent 'de-scripting' across the range of users. For some, such as Biswa and Param, the micro-grid and the 'smart' ideals that went with it, were rejected outright, as symbolic both of state neglect and of the lack of development or 'smartness' in the village. Others pulled apart the operation of the system, as being overly expensive, poorly scheduled and lacking capacity. However, for most, the micro-grid was not just disassembled, but instead, underwent a process of reassembly and of decentring from its initial propositions. For many of the women in the village, this meant reframing its potential around non-'productive' uses, and embedding it within existing lives and practices in the community. For the young men trained to fix the system, it was a process of extracting the value from this training to leverage

opportunities rather than value from the system itself. Ultimately, however, these processes of remoulding and reassembling the system became points of the contention.

A potentially useful analogy for what this did to the system is loosely rooted in the concept of engineering control systems as stable or unstable. An unstable system might be characterised by an uncontrolled nuclear power station, spiralling out of the control of its operators with unpredictable and potentially hazardous consequences. The idea of this instability could be appropriately applied to the micro-grid. To describe the system as unstable is a useful analytic to understand how the diverse and unpredictable consequences and responses to the micro-grid undermined the way it functioned. Along these lines, the term 'disruptive' has been used, and potentially overused, to describe development interventions for some time (Hall & Martin, 2005).Technological interventions, such as those proposed by SolarFuture and those like them, revolve around aiming to create dramatic, transformative changes to the communities in which they are installed. The aspirations placed upon micro-grids are not that they might create subtle and slow shifts, but that they bring upheaval and catalyse change in all aspects of society. In Urjapur the micro-grid was indeed disruptive, but in a way that was seemingly unpredictable, uncontrollable and unstable. This instability was indicative of the multifaceted and non-linearised nature of 'development' Urjapur, where the different strands of perceived progress intersect and clash with each other. It was also inherent of the active engagement of the community it was installed in, unanticipated by the designers. The processes of appropriated agency and *jogad* were a key part of the instability the micro-grid, as well as the interplay within the complexity of the existing structures, dynamics and experiences of those in the community.

The development interventions in the previous chapter could, for the most part, be deconstructed and remoulded at the whim of the community, restricted only by the practical limitations of the projects and by local power hierarchies. In the case of the micro-grid, however, the engineers were very much present in its ongoing use. While the 'smart' system arguably had been envisaged as a means to reassert control over the system, in reality it seemed to place the engineers as being a part of the negotiations and attempts to remould of the system. The system was therefore in a constant state of flux; potentially contributing to the instability within it, as it became an arena for the conflicting ideas, values and aspirations of the people around it. The engagement of Charan, however, opened up wider questions about how other actors in the micro-grid assemblage, particularly those who

seemed to be on the periphery, actively engaged in shaping and reshaping the project. This is explored in chapter 5, which focuses on the role of the state and the forest within the micro-grid assemblage.

5. The Micro-Grid and the Forest

5.1 Introduction

Thus far, the thesis has largely centred on the relationship between the community in Urjapur and the micro-grid and micro-grid designers. The interplay between them provided insight into the ways in which the micro-grid was being negotiated, deconstructed and remoulded. However, there is also a need to explore other human and non-human actors which played a role in the shifting politics around the micro-grid. In particular, this chapter extends the considerations of the previous two chapters to the role of the landscape surrounding the village. It explores the role of the forest and the politics around forest management in the lived experiences of the inhabitants of Urjapur and the intersection of off-grid electrification in these dynamics.

This thesis did not originally set out with a specific intention of engaging heavily with forest politics or conservation. My fieldwork planning was largely limited to finding newly installed micro-grid projects in Odisha and beyond the practicalities of where these were and how I could access them, I did not give significant consideration to their specific geographies and the environmental politics attached to these. However, it became apparent that the forest played a key role in my data. There were a number of reasons why, in retrospect, it was somewhat inevitable that the landscape of micro-grids in Odisha was inherently intertwined with the environmental politics. The interactions between these also gave an insight into the localised enactment of global conservation politics; this provides a powerful backdrop through which to understand Urjapur, but was also one in which solar and development was a key negotiation.

On a local level, by most accounts of those in the community, the forest office and the SolarFuture engineers, the primary reason for the lack of main electricity grid extension into Urjapur was forest conservation legislation. It was said that a ruling Supreme Court ruling had prevented grid extension to the core forest area,[16] in addition to prohibiting roads, large

[16] Particularly given events after my fieldwork where infrastructures were installed that appeared to contravene this (see conclusion), it seemed there was more fluidity in these rulings than appeared initially. However, the forest setting was a fundamental factor in the absence of grid and the decision to implement a micro-grid in Urjapur.

scale canals and phone masts. The forest officer based in Urjapur told us that this was because of rumoured instances of village communities using power lines to electrocute elephants in order to protect their land (Palei, et al., 2014). It was unclear if this was an issue locally or if any communities in the area had attempted this. The framing of the forest-based communities as being a threat to conservation was not unique to Urjapur and crops up regularly in academic and policy circles, particularly in discourses around the 2006 Recognition of Forest Rights Act[17] (Saravanan, 2009). These relate to many of the justice debates around conservation (Williams & Mawdsley, 2006) and particularly many of those relating to indigenous and Adivasi politics (Baviskar, 1994), which often embody legacies of colonial era forestry policies (Vaidya, 2018; Jewitt, 1994).

The absence of grid access was the catalyst for the SolarFuture micro-grid being installed in Urjapur. From its conception, therefore, it was inevitably part of the ongoing contentions between the community, the forest, the nearby wildlife and the structures of forest management, within which the state was a key actor. Looking at state as a whole, there are also clear connections between the politics of electrification with the geographies and the environment. Electrification in Odisha has historically prioritised the more affluent and urban coastal belt and, more recently, extractive and industrial areas (Kale, 2014). Those without electricity were therefore concentrated around more forested and hilly regions of western and southern Odisha. These areas are served more frequently by off-grid alternatives, by consequence of their remoteness and the frequent lack of investment in infrastructure in these regions (Das & Nayak, 2018). The low likelihood of subsequent grid extension to forested areas was also perceived to increase the viability of micro-grids, since the there is no 'competition' from the main grid (Tolba, 1987). Equally, the 'development' component of energy projects, particularly those with international funding, centred around those perceived to be more marginalised and 'underdeveloped'; in Odisha, this often meant those living in forested areas (Heynen, et al., 2019a) and predominantly Adivasi communities. The characterisation of Urjapur as a 'tribal village' was central to the development interventions

[17] This legalisation was intended to redress historical injustices towards forest dwelling communities, providing them with rights to land and other resources (Kukreti & Sahu, 2019). However, since it passed, it has been controversial, with some opponents claiming the law will lead to increased deforestation. In 2019, a Supreme Court ruling enabled the removal of rejected claimants without formal land rights, possibly leading to up to 5 million evictions of Adivasi people (The Guardian, 2019). Households in Urjapur had formal land rights, and so would not have been vulnerable to this, though it was a topic of discussion.

that took place there and featured in the SolarFuture promotional material, despite half the village being non-Adivasi.

From the outset, the community's situation within the forest had been a key factor in the conceptualisation, design and implementation of the micro-grid. Equally, the forest, and the narratives surrounding it, were also the lens through which the Urjapur community interacted with much of the wider world, both in terms of actors, such as the state, and with global ideologies around conservation, sustainability, rights and legitimacy. Therefore, understanding the implications and intersections around the forest and its relation to energy are critical to the wider thesis.

To some extent, the politics surrounding the geographies within which solar projects sit has had limited exploration in the off-grid context. These geographies have been somewhat relegated to enabling or disabling roles, for instance, in terms of causing barriers to the implementation of off-grid technologies. Examples of this include lack of market access in remote and rural areas (Ahlborg & Hammar, 2014) or the environmental impacts of water used to clean solar panels in dusty landscapes (Sarver, et al., 2013). Equally, remote and hard-to-reach geographies also open up opportunities for off-grid energy implementation (Reiche, et al., 2000). These contribute to a wider understanding of why and how renewable energy technologies are or are not designed, implemented and adopted. However, there is space to explore the ways in which off-grid energy projects directly intersect with these localised landscapes and, specifically, the role of these landscapes in shaping the structures around these technologies.

This chapter aims to explore the role of the forest, and particularly state actors associated with the forest, in the intersecting politics around solar (the micro-grid, but also previous iterations of solar implemented in Urjapur) and conservation. This chapter explores the multitude of meanings of the forest in the Urjapur community but focuses primarily on the 'technical' version of the forest as constructed through the processes and practices of forest management and conservation. It argues that while both conservation and off-grid electrification and micro-grid projects coalesce around concepts of 'sustainability', in practice, their relationship was much more contentious. While there were parallels in how the narratives of off-grid electrification and of conservation framed forest communities, there were also dissonances in the aims of these projects. Ultimately, while off-grid energy more generally was appropriated by the forest office to facilitate their operations in the

reserve, the presence and potential for micro-grids was also a threat to their efforts to relocate communities for conservation purposes (Torri, 2011). The ways in which the environment and environmental politics surrounding the micro-grid, in this case the forest, drew meaning from the micro-grid effectively worked to further deconstruct and disassemble the logics within micro-grid assemblage. I argue that actors within the forest management assemblage were also appropriating the meanings and ideas around solar micro-grids in a way which further decentred the technology from its original script and developmental logics.

The intersection of the forest, forest office and conservation narratives with the ideologies surrounding solar electrification and development were first demonstrated to me in a conversation with the divisional forest officer (DFO), who was in charge of the block forest office, based in Angul. Subhra and I had visited his office to get his permission to use the forest road linking Urjapur to the next village along, Karada. I wanted to visit Karada because it had been mentioned multiple times in Urjapur. An AC micro-grid had been installed there several years previously, but had quickly broken down and subsequently been vandalised. Ravi had recommended that I visit it, saying, "They had a solar grid before we did, but it broke. It would be interesting for you to visit and talk to the people there. They got very angry when it stopped working and took the solar panels." It had also been mentioned by the SolarFuture engineers and the OREDA officers in Bhubaneswar and I felt going there was important to understanding the wider attitudes to micro-grids in the area. The meeting with DFO, however, took a different course entirely.

"There are elephants along the road, it will be too dangerous for her to travel there", the DFO said, from behind his imposing desk. He immediately returned to his conversation with the large group of middle-aged men lounging on the seats in front of him.

"The forester in Urjapur agreed to take us in his jeep, he said that would be safe", Subhra said, in response.

Though they were speaking in English, presumably for my benefit, the DFO was yet to acknowledge that I was in the room. Internally, I questioned why elephants were specifically dangerous to me, and seemingly not to any of the communities living in the area, to the forest officers or even to Subhra. However, it was becoming clear to me that 'elephants' were the vague, go-to justification for many forest office decisions, including to not electrify Urjapur

in the first place. He appeared to ignore her response, but, since we were in the only air-conditioned room in the building, we were happy to wait for his conversation to finish.

By this point we had tried numerous times to get permission to visit Karada, a village 15km from Urjapur, further inside the core forest area, but had always been turned away at the manned gate on the road to get there. This was the first time we were talking directly to the DFO about it. It seemed important that we go to Karada and we were both getting frustrated.

Eventually he turned back to us and said, “There are Naxalites around there, it would be unsafe.” The men in his entourage started having quick conversations in Odia. Subhra translated, saying, “They’re saying there were reports of gunfire on the roads around the Mahandi area, saying it would be dangerous for you because of the kidnap risk.”

“But in Urjapur they said there hadn’t been any Naxals since last October, didn’t they? Wouldn’t they have told us if something had happened?”, I asked her quietly, so the DFO would not hear.

The concern around Maoist rebels had been raised numerous times since I had arrived in the area. There were perceptions of a heightened risk towards foreigners. This had already required multiple negotiations with the district police about me doing fieldwork inside the forest at all, as it was said to have low levels of Naxalite activity. Despite the police’s initial concern, they had never alerted us of any trouble. We had both reverted to the expertise of those in Urjapur, including the guards based in the forest, in navigating the risk.

Subhra nodded to me in agreement and told the DFO, “The police [in the reserve] know we’re there and the forester said there were no Naxalites around. We would only go to Karada for a day and then come straight back.”

“Why do you need to go to that village so much?”, the DFO asked.

“She heard about the solar micro-grid there, she wants to go and talk to them about it, that’s her research”, Subhra replied.

“It broke down years ago though”, he said.

“She wants to talk to them about why it failed and what happened and what they think about the system.”

The DFO sighed and said, finally, “You can’t go to that village. If a *firangi* [white foreigner] goes to talk about to them about solar, they’ll think they’re getting help. We finally got them to agree to relocate and this might make them reconsider.”

He was referring to the often-discussed relocation plans, supposedly part of a grand plan to relocate all the villages in the core area of the reserve and then repopulate the area’s dwindling tiger population (Torri, 2011). We had already been told in Urjapur that Karada was one of the only villages to agree to the plan. They were due to move to an alternative location outside the reserve, where all the households would be compensated with farmable land, new houses and cash. The Urjapur community had been made similar offers, but most were suspicious and reluctant to entertain the idea of being relocated. I had not previously considered that my presence in Karada might play any role in this scenario.

We realised by this point that the DFO was not going to grant us permission to visit, so we thanked him for his time and left the office, both feeling somewhat dejected, but also shocked by his justification. As well as being frustrating, the conversation had prompted a critical opportunity for reflexivity about my own role in the field. The link made by the DFO between my presence and potential “help” was disconcerting. I had made every effort to explain to my interlocutors what my research was and where the limits of it were for their own lives and I hoped this had not been misinterpreted. Equally, I was intrigued by the linkage made between the relocation plans, apparently central to the government strategy for the reserve and solar energy and micro-grids specifically.

5.2 The Forest

The forest had a multitude of meanings for people in Urjapur and could be viewed from numerous, overlapping perspectives. Arguably, much like the micro-grid, the forest and the practices and structures associated with forest management, could usefully be framed as an assemblage (Murray Li, 2007), where numerous actors, ideologies and developmental and conservation logics intersect and intertwine with national and global politics around forest management. The breadth and complexity of this assemblage is largely beyond the scope of this thesis. However, there were key components of it, particularly in the alignment of conservation with narratives around sustainability, which intersected with the micro-grid and with off-grid energy more widely in the area. This chapter explores some of the contradictory and counterintuitive ways these intersections played out on a local level (Randeria, 2003).

In order to understand the role played by the micro-grid with respect to the forest, it is first important to understand how the community situated themselves within their environment and the state forces that acted through it. The forest was a constant backdrop to life in Urjapur and, as a geographical, political, economic and cultural entity, impacted every aspect of life there. These engagements, like those with the solar micro-grid, were shaped by varying perspectives and experiences across caste, tribe, religious, age, gender and class groups. Particularly given the community's much longer-term engagement with the forest and with the evolving practices of forest conservation, understanding the community's relationships with it provides an interesting framework for understanding the shifts and negotiations around the micro-grid.

The forest represented a key part of people's identities. This was true across the community and particularly for Adivasi families. India's forests have historically been intrinsically linked to Adivasi cultures, livelihoods and practices (Kapoor, 2010), though these linkages have led to contention between the state and Adivasi communities (Baviskar, 1994). The connection between Adivasi communities and their environments should not be over romanticised, as there was significant complexity to the relationship (Shah, 2010), but the forest was central to both how the communities perceived themselves and how they related to the wildlife sharing the forest. As one older Adivasi woman said to us, after a close shave with a passing elephant eating jackfruit from a tree outside her house, "I know the elephants are dangerous to our fields, but I love them, they're like a part of our family." Her reference to a type of human-elephant kinship was notable (Locke, 2013; Münster, 2014), particularly in contrast to other, caste Hindu members of the community (particularly farmers), and even the forest office, for whom elephants were largely framed as a primary threat from the forest (Shah, 2010). She, like most Adivasi women in the community, had been born in another village inside the forest and moved to Urjapur when she got married. She spoke of the forest with a sense of nostalgia that was common across the village, particularly when the option of relocation was raised. "The forest is our home, we have land here and it's part of who we are", Jaya said, when I asked her why few in the community were interested in the relocation plans offered by the forest office. For Adivasi households, the forest also played a spiritual role, where gods and goddesses derived from the forest were revered in addition to the more typical Hindu deities (Malhotra, et al., 2001; Shah, 2010), which illustrates the extent of their embeddedness within the local environment. The forest was not just a context, but a key actor in the lives of people living there. The attachment to the forest was deeply rooted

across cultural practices, that, for many, went far beyond the narratives of material development opportunities promised in relocation agreements. This attachment embedded their community within their surroundings and mediated their interactions with it.

The forest was often contrasted directly with towns, where people regularly drew comparisons; “Here it is clean and beautiful. The air is clean, and we get a breeze. The cities are dirty and too hot, there is no breeze”. Despite the deep-rooted attachment to the forest, however, there was still a sense of opportunity which existed outside the forest, but which could not be found inside it. Younger generations often idolised the bright lights of the towns outside the forest. This was epitomised in conversation with Jhili’s (introduced in chapter) and her family. She wanted to continue her education beyond 10th standard, but her family could not afford send her to the nearest college and her OBC reservation did not qualify her to attend the tribal girl’s college, reserved for her ST counterparts. Instead, she considered her future in terms of the marriage she might have. “I’d like to have a love marriage, it’s romantic”, she said. Her mother rolled her eyes in response and her sisters laughed. “We go to Angul every 6 months to buy clothes and jewellery.” She showed us the jewellery and *lehenga* she’d worn to her sister’s wedding, “I’d like to marry and go and live in a town or city like Angul. I feel happy and excited when I visit and see the lights and colours and excitement, especially during festivals. It’s good being able to have so many shops close by.” Her mother added, “They should marry outside the forest. He needs to have a stable job and an income. He shouldn’t drink or smoke or chew *paan*.” I asked if they would miss the forest. “Of course!” the girl said, “it’s peaceful here and there is clean air.” Her mother added, “There is no opportunity for jobs inside the forest, I want them to be comfortable.”

Wives and mothers often bemoaned the migration of young men from the village, saying they wanted them to be home, but acknowledging the lack of opportunities for employment within the forest. An older woman said of her son, who, after being trained by SolarFuture as a technician, had left the village to set up an electronics business in Mumbai, “If they hadn’t trained him, he would still live here, instead he’s outside. They should have paid him more to stay in the village and run the grid.” Living in Urjapur was seen as preferable to living outside, where migrating was a last resort (Mosse, et al., 2002). This was twofold; for the most part, wives and children rarely accompanied men in migration from the village (it was said to be practically and financially unfeasible to find safe housing) and so men were missed by their families. But there was also a sense that leaving the village, and the forest, was

undesirable. People discussed the lack of safety in migrating from the village, the pollution of cities and young men missing home. “We have no other choice but for him to work elsewhere”, one mother said of her son. In the same vein, however, there were struggles around those who stayed in the village and got work locally. A woman I spoke to said of her husband, “I’d rather he didn’t work as a forest watcher. The poachers and Naxals are dangerous and a lot of the forest watchers get sick. They have to be the ones to put out fires in the forest and move the carcasses if animals die. There are wild animals in the forest too.” Several watchers died every year from malaria and got sick from dengue. “But there aren’t alternatives. There are no other jobs here and at least this gives us an income. I get to see him every week this way, otherwise he would have to leave the village for work and we wouldn’t see him for months at a time.”

The forest was indeed fraught with dangers, not just for the forest watchers, but for the wider community. Many living practices had changed as the forest had become a tiger reserve and with shifts in national environmental policies. “We used to hunt animals, but then it was banned. We don’t do it anymore because of the ban, but we could sustain ourselves better when we could,” one Adivasi man told me, “We used to be able to protect ourselves and the fields from the animals, but we can’t anymore”. A farmer living on the edge of the community said, “We used to light tyres on fire in between the fields to keep the elephants away, but now we aren’t allowed to do that anymore, so the crops are at risk.” Despite the collective anxiety of the forest encroaching on the village, the collection of food and medicines collected from the forest was still central to daily life, but this also caused stress. “We go to collect mangoes early in the morning when it’s still cool. It can be scary though, there are snakes and elephants in the forest. It’s too hot to go in the day, but we have to be the careful of the elephants around at night,” one woman told me, as she showed me the multitude of pickles, sweets and dried products they made from the forest mangoes. These, along with medicinal plants, spinach leaves, jackfruit and *jamun*, as well as *kendu* leaves to be sold illicitly to *beedi* (cigarette) manufacturers and wood to be used for cooking, were all central to life in Urjapur, but which were seen as increasingly more dangerous to access as the wild animals and poachers came closer.

The relationship with the forest was constantly evolving, but also often framed in the village as being stagnant and unchanging, without opportunity for future prosperity, often due to the forest. There was a sense that the forest was increasingly encroaching on the community,

which was combined with a keen awareness of the limitations and constrictions placed on the community by its placement within the conservation area. Indeed, it was the facet of the forest as being a site for conservation and for control by the state that was often most spoken about with relation to development in the community. This was illustrated for me during a conversation with the head of the village school committee, Bikash. He was higher caste, from a non-Adivasi family and had somewhat different reflections on the environment.

“Is she from the government?”, Bikash asked Subhra immediately, gesturing at me. He didn’t seem unfriendly, but was cautious. Jaya had taken us to his house in Gopal Sahi.

Before Subhra could reply, Jaya rolled her eyes and said, “Does she look like she works for the government? No, she’s here talking about the solar.”

He looked Subhra and I over for a second, before sitting down next to us and replying, “We can talk about solar, but what about all the other issues here?”

I asked what he meant.

“I’m chairman of the school board. We’re supposed to organise school meals and facilities and keep track of teachers. It’s our job to make sure students attend school. But what’s the point when the teachers don’t teach or even show up?”

I asked why the teachers didn’t come.

“No one wants to live and work in the forest. There’s malaria here and no phone access or electricity. Why would they come here?”

Before Subhra or I could say anything, he launched into a tirade about the state of the village, reminiscent of discussions with Ravi, Biswa and Param described in previous chapters.

“Education is supposed to help us develop, but how can we when the teachers don’t come? We can’t get good medical care because Simulia only gets a doctor once a week. Every time it rains, we can’t use the road, so we can’t even reach Simulia. We have no pumps for irrigation and our crops are destroyed by animals. We used to be able to protect our fields with guns, but now we have no way. They give us some crackers, and the elephants aren’t scared of them anymore. Nothing will ever change like this, we are stuck.”

Subhra asked what he thought would help them.

“We need a fence built, but the forest officers say that would disrupt the paths of the elephants. They say they have no engineers to build it anyway. We need more borewells to irrigate, but the forest only makes irrigation ponds for the animals to drink from.”

I asked about the solar fence we’d seen on the drive into the village.

“That broke in weeks, the elephants just pushed it over.”

It was true that several of the huge concrete fence posts had been toppled over like giants had passed through the village; only the day before Subhra had commented on it, wondering what had happened.

The points he raised were not new; they were spoken about across the village. He was angry, but mostly seemed frustrated, questioning how the village was supposed to improve its situation while so many barriers were in their way.

“How do you feel about relocating? If you were outside the forest you wouldn’t have to deal with these issues?”

“I never wanted to leave, but things don’t get any better and I don’t see how they will. Maybe it would be better to be outside the forest and away from the animals.”

For those living in it, the forest was full of contradictions. It provided resources, but limited opportunities. It was a place of comfort but also of danger. It provided clean fresh air and open spaces, but also cover for illegal activities. It was a place of openness and freedom, but also of claustrophobia and control. Even for Subhra and I, many of these contradictions were apparent in the relatively short time we were there. It felt wild, precarious, uncontrollable and chaotic, but also calm, quiet and peaceful. While it felt like a remote place on the periphery of external modernity and state influence, it was also closely watched by the forest office and our movements were controlled. It was part of ‘nature’ but also an instrument of state bureaucracy (Mathur, 2016).

It seemed that many of the contradictions around the forest were rooted in, and derived from, the practices of forest management and the bureaucratised versions of environmental conservation. In conversation with Bikash and others, there was a ‘before’ and ‘after’ where the community’s relationship with the forest had shifted when it became a protected forest area and then later a tiger reserve. These shifts seemed a process of the community losing itself and its agency to the forest. It spoke of a happier past when the community had a more

balanced relationship with the forest. This is not to romanticise life in the community before it became a protected tiger reserve; people also spoke of the challenges of living there the past, through drought and famine. However, the rendering of the environment as an area to be conserved seemed to fundamentally shift much of the contention and discourse around it. There was a sense of the balance of power having moved from the community to the forest, and a loss of control at the hands of forest office regulation.

5.2.1 Awareness Camp

The deeply rooted contradictions and contentions within the state forest office's engagement with the community were most viscerally presented to me during a conservation camp which took place in Urjapur a few months into my time there.

The conservation 'awareness' camp was run in the common area of the ecolodge. Given the ubiquity of the forest in the community, it was unclear what exactly the awareness camp was intended to make people aware of. Preparation for the camp followed a similar pattern I witnessed numerous times in Urjapur. The forest officer permanently based in Urjapur (there to ensure the community complied with the rules of the forest and ensure no hunting, illegal collection of forest products or collusion with poachers and Naxalites) would send word around that someone from the government was coming to the village. It could be for an awareness camp, or a ceremony inaugurating a project or even as part of electoral campaigning. Other than Ravi and Jaya, people rarely knew, or appeared to care, who was coming for what purpose. At the ecolodge, plates of biscuits, *chakli* and samosas would be prepared, copious amounts of tea would be brewed, fresh flowers would be hung for the occasion, fresh paint would be applied around the lodge and any stray dogs, goats or chickens would be shooed away as an audience of community members would be assembled. Most often, however, the visit would never take place. The politician or official would be called away on other business and everyone would relax and go back to normal, usually with little apparent resentment at the inconvenience the non-visit had caused. The prepared food always got eaten anyway.

This time, however, the camp went ahead. A large banner announcing it was hung in the ecolodge, with the Indian government and forest office logos alongside those of the Japanese International Cooperation Agency (JICA) and Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ). Around 30 people from the village attended, though some were seemingly strong-armed into being there. They were a mix of older men and women,

with no young people attending, except those already working in the ecolodge. They arrived at 8:30 in the morning and waited for an hour until the forest officers arrived in a convoy of imposing white jeeps. The Forest Ranger ran the camp. He was the second highest ranking officer in the reserve, ranking directly below the DFO. He was accompanied by a number of other forest officers. The village attendees sat on one side of the space, and the forest officers arranged themselves on the other, in order of rank. Tarak, as a retired forest officer, was invited to sit on the side of the forest officers in the seating arrangement, separating him from the other villages and a clear sign of respect towards him. There was a clear divide and hierarchy between the forest officers and the community.

The Forest Ranger opened, saying, “More and more of India is becoming a desert. One day the forest could be like the Thar desert in Rajasthan. The changing climate is causing shifts in the weather. There is a more unpredictable monsoon and extreme cases of droughts, floods and cyclones.”

Those in attendance nodded in agreement. The unpredictability of the monsoon had been a regular topic of conversation, particularly as farmers planned their planting schedules for July and August. People were aware that weather and climate patterns were changing, though none mentioned why this might be.

The forest officer continued, “Vultures and other animals are becoming extinct. Soon they’ll be gone like the dinosaurs. Sea levels are rising and it’s because of the exploitation of forest resources.” The implication was that those living in the community, as forest dwellers, did, at least in part bear some of the responsibility for the rising sea levels. “There’s too much population and depletion of the water table from too much pumping for irrigation.”

The issue of the water table was one of debate between farmers in the community and the forest office. Farmers wanted to sink more borewells to irrigate from, as the small number of irrigation canals from the Mahanadi river were ineffective. Almost all farming was rainfed, which was increasingly precarious. The forest office resisted, saying that borewells would decrease the water table across the reserve and cause water shortages for the animals.

The speech, which lasted around half an hour, was directly appealing to the community members to take responsibility for these issues. He urged the community to take oaths to protect the forest, saying, “Everyone is saying the government should take care of it, but we should be concerned… it’s our land, our home and our future”. He urged every family to plant

trees to reforest the area and said that because of high rise buildings sparrows would become extinct and that one day humans would be extinct. Finally, he said, “GIZ and JICA have funded forest preservation projects. As far away as Germany and Japan, people are depending on us to preserve these forests”.

Though the event was branded with the forest office, GIZ and JICA logos, it was unclear where the mandate for this camp had come from, or what it was intended to achieve. Despite the pageantry of his entrance and entourage, the references to these outside bodies indicated his part in the much larger global assemblages around conservation and forest management. The narrative of blame, however, was clear. He blamed high rise flats for the endangerment of sparrows, to an audience living in a village without a single multi-storey building. Overuse of water was blamed for desertification in a village without pumps and borewells. However, the speech implicated those living in the forest as being as the biggest risk to it and those who would pay the price for its conservation. The hypocrisy was palpable, on both a global level, and a local one. The tiger reserve was less that 50km from Angul, one of the most highly industrialised and polluted towns in the state and beyond that were the Talcher coalfields, one of the biggest open cast coal mines in Odisha. Those in Urjapur consumed none of the coal or the energy produced by the coal, since there was no grid connection. The steel and aluminium produced in Angul was not used by anyone in Urjapur. Those in the reserve were living under the constant surveillance of the forest office, and forgoing access to healthcare, roads and electricity to prioritise the forest and yet it still was not enough.

Some of this hypocrisy was not lost on the audience. Some asked if the forest office would give them more support in protecting fields from the elephants. They pointed out that if their crops were safe, they would have no reason to interfere with the forest. Someone mentioned building a fence around the village and said they needed more crackers. In response, the Forest Ranger said, “If you leave fruits out for the elephants, they will take those instead of trampling the fields. They will be happy with that.” The person who had asked the question replied, pointing in the direction of an ill-fated orchard of trees that had been knocked over by elephants like skittles, “You want us to plant trees and we planted fruit trees, but in a day they had knocked them all over.” Everyone in attendance nodded earnestly, but later, once the forest officers had left, Jaya, Ravi and Mukesh laughed about it.

The awareness camp was indicative of attempts to cast blame on local communities for environmental degradation (Rai, 2019). The forest officers leading it leant on a technical

construction of the forest as produced by the state forest office and endorsed by international aid organisations. Through this, they constructed local populations as the primary risk to the environment. Any nuance about what other versions of the forest existed, or how local communities related to the forest in alternative ways were seemingly written out of this construction. This was reminiscent of energy narratives which emphasise renewable energy options for the rural poor, in anticipation of a potential future carbon output were they to 'develop' (Hostettler, 2015). Arguably, they both serve to construct an 'other', who can be framed as the uneducated risk to environmental sustainability (Jewitt, 1994).

The community inevitably had their own discourses on conservation and their own narratives of blame about the degradation of the local wildlife. No one disagreed that the forest was something to be preserved and protected, but many alleged that the forest office was more interested in their own interests than in its conservation. Some went as far as to suggest that the forest office themselves colluded with poachers in the forest and they were generally considered to be corrupt. "How does a tiger reserve go from having 6 tigers to none in ten years? They were supposed to be protecting them!", one man said. While the forest office maintained that at least two tigers existed in the reserve, going as far as publishing information on their tracking of the tigers through footprints, most in the community were cynical.[18] Jaya said, "I saw them a handful of times when I was younger, but no one has seen a tiger in the reserve for years." Parashar, one of the oldest men in the community was sceptical about the forest office's founding principles; "When it was established the newly appointed officer brought crocodile eggs and kept them in an incubator till they hatched. They bred crocodiles in the river and sold their skins for money. Now [the area] is a huge reservation zone for crocodiles, but it started with corruption. They are self-interested." No one in the community saw themselves as a risk to forest, but many mistrusted the forest office to protect it. The version of the forest that had been constructed as a conservation effort was seen much more by the community as a vehicle for state corruption (Robbins, 2000).

[18] The politics of tiger conservation in this context were fascinating, particularly in the ways that inflated tiger populations had been imagined and were perpetuated. They are largely beyond the scope of this thesis but spoke to the construction of different types of bureaucracies around conservation and human-animal relations (Mathur, 2016) but also the symbolism and charisma around tiger conservation (Jalais, 2014).

5.3 Solar and the Forest

At first glance, there seem to be compelling logics for implementing a micro-grid within the tense dynamics between the community and the forest and forest office. They fit into some of the narratives surrounding solar PV micro-grids as illustrated in the introduction of this thesis. Could micro-grids indeed be the 'silver bullet' technology that enables 'modernity' and 'progress' without compromising the 'natural' habitats of the forest? Could micro-grids provide an equivalence to rural electrification programmes without the environmental degradation associated with such infrastructures? Could the clean air so often mentioned by the community be preserved with the installation of 'clean' energy? And if the micro-grid could be installed in the village without causing explicit degradation to the wildlife, could the promises that came with solar energy (micro-enterprises, education opportunities and healthcare provision, among others) be realised?

The forest, particularly the version of it constructed by the forest office, was an entity which served to isolate the community, in its limited access to roads, grid connections and communication networks. This could be part of facilitating the idealised Gandhian, self-sufficient village often evoked with relation to micro-grid systems (Holmes, 2017; van Gevelt, et al., 2018). It provided a compelling image of the decentralised production of energy to create self-contained, eco-aware communities that also fit within conservation narratives.

On the surface, it seems to be a persuasive argument, and presumably one which contributed to micro-grids being installed in both Urjapur and nearby Karada. Both conservation and solar energy provision find themselves attached to 'sustainability' as a signifier (Davidson, 2010; Brown, 2016), and would be expected to coalesce around this alignment. If it was the physical infrastructure of a grid running through the core forest area that was the threat to the ecological landscape, it stands to reason that decentralised electricity infrastructure without that should sidestep this issue (Palei, et al., 2014). On a global level, much of the justification for off-grid renewable energy has engaged with the idea that if the 'poor' were to consume electricity at the rate of those in the Global North, the climate consequences would be devastating (Hostettler, 2015), stimulating the narratives around both 'leapfrogging' technologies (Szabó, et al., 2013) and 'appropriate' technology[19] (Schumacher, 1973). This

[19] Note that the 'appropriate' technology movement (the promotion of low-tech or 'appropriate' technological 'solutions' to development issues), based on the work of E. F. Schumacher and influential in some international development circles, is distinct from discussions in this thesis about processes of appropriation with relation to agency and power within development projects.

resonates with logics which placed the Urjapur community as being simultaneously potential threats to conservation practices, but subsequently becoming 'protectors' of the environment through their engagement in conservation programmes. These were demonstrated in the awareness camp, where the forest office, on behalf Japanese and German aid organisations, placed a disproportionate environmental burden on those making the least impact (Baviskar, 1997).

As explored in the previous chapter, the micro-grid went through numerous processes of evolution, but there remains a question about the role that the forest played in adhering the micro-grid assemblage. These logics around sustainability might indicate that the narratives around solar and forest conservation could be mutually reinforcing. However, over the course of my fieldwork, it seemed that these logics did not play out as might have been anticipated. Instead, while the micro-grid played a role in conversation narratives around the reserve, these were shaped less by enabling sustainability logics, and more by the existing politics, tensions and bureaucracies. I argue that the forest office were also working to appropriate the micro-grid, alongside other off-grid energy technologies, to suit their own ends. These processes served to reshape and remould the micro-grid assemblage by pulling alternative meanings and understandings from that project and drawing out a whole other set of implications for the forest context.

Solar energy had long been part of strategies by the forest office to attempt to 'placate' unhappy, and potentially rebellious, communities in the reserve. In 2014, a number of strikes and protests took place against the draconian rules of the forest office in attempts to resist the overbearing conservation rules put in place (Holmes, 2007). The ability or means to protest seemed to correlate strongly with gender, caste and wealth structures in the area, with groups of land owning, higher caste Hindu people predominantly leading and participating in these movements, including those from Urjapur, such as Ravi's family. According to a local environmental activist, those protesting erected road blocks at the entrance to and throughout the tiger reserve, objecting to the lack of infrastructure, cancelled electrification plans, elephant attacks and, the last straw, newly introduced rules banning the playing of loud music late at night for wedding functions, lest they disturb the animals. These protests had forced the forest office to make a number of concessions. They apparently made a number of promises to 'deregulate' certain areas of the reserve that were under strict conservation rules, enabling the sinking of borewells within community areas

among other things. While these were promised in Urjapur, they still had not come into effect. The forest office also provided new solar home systems to households in the reserve in unelectrified communities. These were run free of charge (which created the subsequent tensions with the micro-grid in Urjapur) and joined the array of solar panels installed on the roofs of the thatched houses. The rules about music were not changed.

Similarly, during one particularly dry summer when elephant attacks reached a new intensity (apparently the elephants were more likely to encroach upon communities when there was less food available deeper in the forest), communities across the reserve caused disruption, setting fires in the forest and blockading construction projects, such as those building reservoirs for animals to drink from. In response, the forest office erected solar electric fences around the villages in the core areas in an attempt to be seen to be protecting crops, and installed solar streetlamps and water pumps within the villages. The home systems, water pumps and streetlights were, by all accounts, often faulty. The solar fences were quickly knocked down by the elephants, as Bikash had mentioned. Thus, the grumbling from farmers about their ruined crops, the resentment at having no grid electricity and the frustrations with having to pump water by hand began to slowly rise again. The solar, however, had served its role in placating protesters when it was most needed. No doubt, when tensions rose again in future, solar, and potentially other developmental strategies, would be employed as sufficient appeasement to avoid all-out rebellion, though without necessarily 'fixing' the problems at the focus of the protests.

Much like the responses to the micro-grid in Urjapur, the value seen in these solar 'offerings' from the forest office were varied. By and large, the practical utility of them was limited, since the systems broke, were never adopted or were simply not fit for any purpose. For some they played a part in brokering 'peace deals' within social upheaval, acting as something of a bargaining chip for those in the community wishing to extract as much as possible from the government, such as Ravi's family. They by no means meant that Ravi would reduce his visits to the block offices to petition for more resources, but potentially enabled some kind of stop gap arrangement. Solar energy, in the form of these devices and innovations, formed part of the delicate balance between the forest office and communities in the reserve, with the forest office aiming to do the bare minimum to restore and maintain social order and the communities pushing back as far as they felt able to without risking potential backlash. For those in the community who felt they had little role to play in strike

action, the solar was met with mild amusement or disinterest. No one in Urjapur seemed particularly angry or annoyed when the solar home systems implemented by the forest office broke. If anything, it strengthened the reputation of solar energy as something that would break down. When the solar fence was dismantled by the elephants, farmers were frustrated and annoyed because their fields were at risk, but most in the community were unsurprised and seemed resigned to it. Useful components, such as the batteries, were taken for other purposes, but otherwise they were largely ignored. In this sense, these solar objects played a role in reinforcing and adhering the assemblage around forest management much more than they achieved anything of their own. The forest office made use of them to broker and enable certain relationships between the community and the forest, in a way that was reminiscent of how the community appropriated development interventions to leverage their own outcomes.

However, when it came to the solar energy installed in the form of micro-grids and by organisations other than the forest office, the perspectives on solar energy and conservation were reversed and engaged with an entirely different set of narratives around the presence of communities in the reserve and the potential for relocation. Subhra and my conversation with the DFO was an explicit demonstration of this. In his eyes, if I had visited Karada and asked questions about the micro-grid, this might have sent a message to the community that they might be provided with alternative technologies for electrification. He implied that they might backtrack on their agreements to relocate from their current location and the forest office plans to move the village to enable tiger relocation would be derailed.

This scenario illuminated an entirely different set of logics around micro-grids and conservation, undermining any presumed alignment they might have around ‘sustainability’. By the forest office’s reasoning, the presence of communities within the core forest area was effectively a threat to conservation efforts. If micro-grids served to facilitate this presence, it was, in effect, undermining conservation efforts. Solar energy had been provided by the forest office in order to support and enable certain outcomes, but it could also be tactically withheld to facilitate other outcomes, such as the relocation of villages. The provision of micro-grids by actors outside the forest office effectively undermined the control they could leverage over the communities in the area.

This was echoed in the conversation with Biswa and Param about the micro-grid in the Urjapur. When I asked Param whether he would want to relocate from the village like those

in Karada had agreed to, he responded saying “Now we’re a smart village, they wouldn’t relocate us, even if we wanted to”. Though the ‘smartness’ of the village was spoken about with irony, he implied that the system, and presumably the press attention and investment it had alongside it, had changed the community’s relationship with the forest office. It had served to reassert the community’s permanence in the forest and to provide a level of safeguarding against relocation. However, it should be noted that, regardless of how it was viewed by the forest office, the micro-grid did not appear to represent a route to permanence or legitimacy to the Urjapur community using it; in no way was the micro-grid ever spoken about as providing ‘recognition’. If anything, it was seen as symbolic of a lack of care, not as a way to mobilise greater rights and leverage any agency with respect to the forest office. It was notable that the forest office’s drives for relocation took little notice of many other ways by which communities were embedded within their environments, through culture, traditions and lifestyles. It was somewhat arbitrary that the presence of the micro-grid project, which seemed so unstable and contested, could be the factor which afforded the community a level of legitimacy in living there.

I was not in Urjapur when the micro-grid was being planned or implemented. It would have been interesting to have understood more of how the forest office responded and if they resisted the project. The micro-grid was facilitated through OREDA who, while also a government body, did not necessarily share the same mandates that the forest office did. However, it was clear that the version of conservation and sustainability sought by the forest office was not necessarily compatible with the version of sustainability proposed by micro-grid electrification. Equally, for those living in Urjapur, the micro-grid seemed to do little to mitigate the challenges that were perceived as a result of the restrictions from the forest office. Some of the most pressing concerns for those in the community centred around their position in the forest and it presented constant anxieties, from numerous different perspectives. Despite claims of aligning with sustainability narratives, in practice the micro-grid did little to serve the community in navigating the disproportionate prices that they were paying in the name of ‘sustainability’ and conservation.

5.4 Conclusion

There were clearly problematic components in how the forest office, with the support of wider state structures and international donors, mobilised efforts for purported ‘conservation’ in the reserve. Their practices were indicative of abuses of power and insidious

environmental justice issues, that were reflective of many of the wider concerns about how forest communities are treated in India (Baviskar, 1992; Williams & Mawdsley, 2006). These particularly reflect concerns around Adivasi rights, which, while rooted in colonial forestry practices, are very much a contemporary issue in modern India (Munshi, 2012). It was clear that the way the forest office operated was a fundamental component in the experience of oppression for those living there. There was significant, and arguably well placed, anger towards the forest office, though coupled with the more complex feelings towards the forest itself.

The intersection of off-energy provision within this provides interesting ground for enquiry. The forest office, along the lines of the Urjapur community, the micro-grid designers and other state actors explored in previous chapters, appropriated off-grid energy technologies to support their own mandates and aims. Small scale solar had become part of a range of tools they used to placate frustrated communities. These were largely ineffective in achieving developmental outcomes, but did serve to provide a semblance of care in the face of protest movements. By contrast, micro-grid projects seemed to be received differently, with greater resistance from the forest office and concern that they would undermine efforts to relocate entire communities (Torri, 2011).

The forest was a critical component in the processes of disassembly and reassembly of the micro-grid project. It played a key role in rendering new ideas and meanings in what the micro-grid was, both in terms of how the community conceptualised the micro-grid with reference to their own circumstances, and in terms of how the forest office drew entirely different meanings from the system. This chapter demonstrates the importance of extending considerations around micro-grid projects beyond the binary relationships between those designing and implementing projects and those using them. Highlighted within this are the conflicting development and sustainability logics around the micro-grid, which were arguably contradicted by how the forest office conceptualised it. There is potential to extent the theoretical assemblage approaches used to conceptualise the negotiations around the micro-grid to encapsulate the forest as a non-human actor within this (Murray Li, 2007).

The landscape and environmental politics were central to shaping how the micro-grid was received and how it evolved, was appropriated and remoulded. These were very apparent within my fieldwork, primarily because it was located in a place that was demarcated as a conservation area, and where tensions around the environment were an overbearing part of

everyday life. However, I would suggest that the active role of the local environment within the micro-grid assemblage was not unique to the forest. Instead, there is potentially a more generalisable role for localised landscapes in explicitly shaping the politics, experiences and implications of micro-grid projects (Bridge, et al., 2013). In this, the geographies, ecosystems and environments surrounding micro-grid projects are arguably actors in and of themselves in the assemblages around them, and could be researched as such. Equally, this chapter demonstrates the importance of interrogating the logics which mobilise and justify micro-grid projects in all localised contexts (Cloke, et al., 2017; Ahlborg, 2018). Any presupposed universality of the 'sustainability' of such systems is inherently tied to their context of implementation and to the perceptions and politics of localised user communities and wider engaged stakeholders.

6. The State of Micro-Grids

6.1 Introduction

When I first arrived in Odisha on fieldwork, I spent the first few weeks visiting NGOs, government departments and businesses working in the off-grid solar and micro-grid space in Bhubaneswar, the state capital. At this point, I had not finalised the selection of the Urjapur micro-grid as my main field and was looking to see what other options there might be. I was particularly keen to find a site where the micro-grid was in the process of being installed, so I could undertake a more longitudinal study of the processes of implementation of the technology. While numerous rumoured or promised projects were suggested to me, they all had vague timelines, which depended on unclear funding sources and future meetings with communities, which seemed unlikely to come to fruition. This period in Bhubaneswar, however, provided a fascinating insight into the wider landscape of micro-grid projects across the state. I followed up many of these contacts later and made several visits to micro-grid projects elsewhere. These were only short visits and interviews so provided insufficient detail to draw comparative conclusions with the experiences of the Urjapur micro-grid, and there are few detailed ethnographic accounts of other micro-grids that can provide this. However, they did raise interesting points about how the micro-grid projects in Odisha interacted and how the differing strategies impacted and why they were implemented, what usage was prioritised and the ways in which the micro-grids broke down or became superfluous. This data not only allows reflection on the extent to which the issues and debates around the Urjapur micro-grid can be generalised and scaled across the state, but also helps to understand how the ideologies, structures and values attached to the Urjapur micro-grid fit within the wider network of off-grid provision. Ultimately, the data from interviews and visits to other micro-grids frame the Urjapur micro-grid within a network of actors and relationships that went much wider than the forest context, where micro-grids were both mobilising and mobilised by a diversity of aims, visions and approaches to development, embedded within often discordant developmental politics. These discordances served to undermine many of the logics that helped to assemble not only the Urjapur micro-grid, but also other iterations of micro-grid assemblages in different areas of the state.

This chapter uses ethnographic data from visits to micro-grid sites across the state as well as unstructured interviews with men (and they were entirely men) from the organisations responsible for installing them. This chapter is split into three sections, reflecting the three main groups installing micro-grids. Firstly, it explores the NGO micro-grid ecosystem, looks at the NGO model of micro-grids, particularly the 'community-based', grassroots organisations typically working in water and sanitation (WASH), education and agriculture, who have added off-grid energy projects to their portfolio of existing 'holistic' community engagements. Secondly, it focuses on government. It looks particularly at OREDA, the state renewable energy agency, who had interactions with local BDOs and forest offices to support installation of micro-grids within a wider remit of off-grid renewable energy interventions. Finally, it looks at the companies and private sector organisations, such as SolarFuture, who were beginning to explore the scope for marketizing solar micro-grids in the state, though with limited success. While there were many overlapping narratives with which all these three groups engaged, they each had distinct values, ideologies and approaches in how they approached micro-grids, many of which were apparent in the ways in which they went about designing and installing these systems (Sharma, 2020). Critically, all the implementors of the micro-grids in this chapter had very specific ideas about who and what their users would be. These were somewhat technologically deterministic in their assumptions (MacKenzie & Wajcman, 1999) and emphasised the role of technology in casting users in specific roles (Akrich, 1992). By and large, this was rarely deconstructed by the practitioners themselves.

For the most part, everyone I spoke to had prior and concurrent experience in a wider range of solar goods and projects. The step into micro-grids was a move towards more efficient systems with a closer approximation to the grid (Raman, et al., 2012). For organisations working across the state, including SolarFuture, there was often a strong implication that installing micro-grids was a show project or 'proof of concept'; they seemed to engage much more in the allure surrounding the micro-grid than the reality of the systems themselves. In reality, most projects seemed precarious at best, and many of the projects I visited and spoke to people about had failed, often long before I arrived. Patterns in the way in which these projects had failed which were arguably inherent in the way the projects were structured, the ideologies upon which they were formulated and the ways in which local communities responded to them.

A loose typology for this could revolve around three means by which micro-grids 'died' and were useful for understanding the developmental logics, and failure of these, that had been 'scripted' into them. As with any technology or system, decay and breakdown were inevitable parts of their lifespan (Trentmann, 2009), though the nature of this and the time taken for these were impacted by design and usage parameters. However, the subsequent repair or upgrade was largely dependent on proactives response from the implementors, or potentially the users (though there are limitations in localised capacity to do this (Palit & Sarangi, 2013)). Thus, the first type of 'death' of micro-grid was abandonment by the project implementors. Parts would break or wear out and no one would come to fix it. As will be explored, organisations had different modes of allocating responsibility for this. Secondly, there were cases where the main grid would be extended to communities formerly served by micro-grids, which would render the micro-grid obsolete. The presence of the grid would undermine usage, payment and governance mechanisms for the system and the micro-grid would die through a process of competition (Sharma, 2020). The final way in which the micro-grids projects seemed to die, and one that potentially coincided with a much wider proliferation and awareness of solar energy in the rural areas, was a death through disillusionment. Many communities did not want a micro-grid, because they wanted main grid instead, they did not want to pay for solar, they did not see potential opportunities that could come from it, or because they did not trust the technology to function. These projects often seemed to die before they took off. There are definite overlaps between these mechanisms of project failure and aspects of all of them could apply in the projects implemented by different sectors, but some of the commonalities and patterns that did arise will be explored in this chapter.

All three of these modes of micro-grid failures fit within the wider arguments of this thesis. Across the state, micro-grids were politicised within both developmental politics and within localised perceptions of these. The failings of micro-grids came again from the ways in which actors around them were attempting to mould them to their own understandings of what they could be. They were being mobilised to support specific development ideologies, and effectively being deconstructed by the dissonances in these ideologies.

There are clear unknowns in the data in this chapter. There were numerous instances where I wished I could spend weeks or even months in the communities I visited, much as I had done in Urjapur. This was limited by the time available for fieldwork and my decision to

prioritise time in my primary field site. While I was able to access the implementors of micro-grid systems on many of these projects and understand how they put meaning, ideologies and influence into their systems, it was much harder to understand how the communities themselves extracted meaning from these. This was also indicative of the gaps in the understanding of those project implementors themselves in how communities felt about their micro-grids. Particularly where micro-grids had been installed and had subsequently broken down several years earlier, it was difficult to capture the full legacy of what had happened and I had many unanswered questions about why certain decisions had been made and why projects ended up the way they did. This demonstrates many of the unknowns across the micro-grid sector and arguably precipitates a need for a greater quantity of in-depth, situated studies of such systems in numerous different contexts and with differing configurations. However, despite the potential gaps in understanding, there are interesting and pertinent conclusions to be drawn from the wider scope of micro-grids across the state.

6.2 NGOs

In my first few weeks in Bhubaneswar, the most prominent groups creating a buzz around the installation of micro-grids were NGOs. These ranged from national and international agencies with operations in the state to more locally based organisations. I became aware of at least five who had installed micro-grids and many more who were working towards their deployment. Some were collaborations between organisations, where the funding came from one organisation (often with links to international donors) while another would work on the community implementation. Over the period I was there, I interacted with four different NGOs working in the micro-grid space, mostly through interviews but also undertaking field visits.

The NGO micro-grid projects often contrasted with those originating in government departments and enterprises solely working on energy access, in that they were usually part of much wider community development programmes. This was described to me by a programme officer from one of the most influential 'grassroots' NGOs in Odisha.

> *We only work in villages where we have a presence. We take a holistic approach to micro-grid installation, working on energy access alongside WASH, education and agricultural development; energy access alone won't help people. The villages would be identified as those without grid and where this situation is unlikely to change in the foreseeable future. A key component of the model would be the cohesion of the*

community, since the micro-grid would be supported with a community committee and the emphasis placed on the community to run, govern and maintain the micro-grid. We usually train locals to perform basic repair and maintenance and set up community accounts for the collection of payment. This payment would be expected to pay for the future upgrades and replacement to the system parts, but the initial capital costs would usually be covered by donations and funding. While the control of the system would rest with the community, the NGO would continue [to provide] hand-holding. We would anticipate that the system could be self-functioning at some point in future.

Their approached resonated with many facets of their wider development ideologies, reflecting many of the 'grassroots', community-based organisations working throughout South Asia, with roots in Gandhian voluntarism and the Christian missionary system, amongst others (Sen, 1992). Their holistic aims emphasised participation and community engagement (Fernandez, 1987). The micro-grids they installed, rather than a 'silver bullet' technology as framed in other narratives, were treated as one of many village interventions, such as installing toilets, establishing schools and forming self-help groups (SHGs) and farmer cooperatives. This was partly an acknowledgement of the limitations of micro-grid technology in 'developing' communities. However, the existing NGO presence was also seen as a critical way to facilitate and embed (Ulsrud, et al., 2011) the technology within the community and was central to its ongoing operation. While the systems were primarily funded by the NGO (often through donors), much of the NGO's efforts were to make the system self-sustaining, with operation and governance entirely within the community (in striking contrast to the 'smart' control system of the SolarFuture micro-grid).

By and large, there was an acknowledgement of the tension between the main grid and the micro-grid across the state; the micro-grid was seen in direct opposition to the grid, where the two would not, or could not, coexist. It was implied that the main grid would make the micro-grid both unfeasible and unnecessary.[20] However, in conversation with NGOs, the aversion to placing micro-grids near areas with grid access also seemed to stem from a more political and ideological stance. The 'self-sustaining' narratives that went along with the

[20] This was something I heard across Odisha in multiple sectors. However, some private sector organisations working in other parts of India, such as the Mlinda Foundation working in Jharkhand and Mera Gao Power working in Uttar Pradesh (Bhattacharyya & Palit, 2016), have installed micro-grids in parallel with the grid, arguing that micro-grids can offer more consistent electricity so still has a role to play both in community development and businesses models. There are arguably contextual nuances that makes this more feasible in other states, some of which are explored in this chapter.

micro-grids were framed as routes to localised 'empowerment' for communities, but which went alongside the expectation that communities had to take responsibility for running their own systems and making them sustainable in the long term.

All the NGOs I spoke to saw the creation of village councils to manage the micro-grid and training of the local community as central to 'embedding' the micro-grid system. Most invested time and money in developing livelihood opportunities alongside the micro-grid, by setting up small training centres and providing loans for machinery. The ways in which these micro-grid projects were planned and implemented embodied the values of the organisations as a whole. They prioritised the idea of local collaboration and community-building as routes to empowerment and self-sustainability. It was a model based on the principles of a type of self-sufficiency, which resonated with Gandhian notions of *gram swaraj* (self-governance) and community cooperation (Jain, 1988), rejecting more dominant centralised state narratives (Sen, 1999). These values and ideologies were very much 'scripted' into how the micro-grid operated and how they were intended to function. The head of one NGO specifically touted their potential to reduce dependency on the state, which he saw as being unreliable and corrupt. He argued that micro-grids were better suited to localised adaptation and 'DIY' electrification. The ways that NGOs utilised them were equally politicised, in effect as an attempt to bypass the state-run grid and to create localised 'self-sufficient' communities. This resonates with wider conceptualisations of electricity grids as being extensions of state control (Power & Kirshner, 2018). Much like the Urjapur case study, the ways that micro-grids were employed drew from specific concepts of how rural villages *should* develop. The micro-grids were, in effect, deployed to create a certain type of user; in this case, self-sufficient, engaged communities who took responsibility for their own development.

Despite the rhetoric around micro-grids and their potential within community-driven development, it was striking that each organisation only had one or two projects. Unlike their WASH, education and livelihood programmes which would be replicated in hundreds of villages, there was a clear contrast in the case of the micro-grids. The way they were presented made them seem like showcase projects, which garnered attention and generated a buzz, but were apparently not effective or 'scalable' enough to be replicated elsewhere (Singh, 2016). Every NGO I spoke to immediately offered to take me to visit their micro-grids, saying I could stay in their local guesthouses and meet local staff; these organisations were

clearly aware of the value of showing visiting researchers, potential donors and collaborators their operations. However, these visits never materialised and instead became indefinitely postponed. I was aware that the staff in these organisations were busy and that ferrying me around the state was probably a low priority, but some of the reasons why we could not visit seemed to relate to the realities of these projects. Many were said to be in disrepair, awaiting upgrades and maintenance in the near future to put the systems back in working order. Others I visited independently and, without exception, they were all non-functional.

One village in particular, Bhujanga, was symptomatic of this. It was funded and installed in collaboration between by a local NGO and international and Delhi-based partners. Bhujanga was one of three hamlets where micro-grids had been installed in a small forest reserve in Dhenkanal district. Less than two hours from Bhubaneswar, the project was representative of many high profile development projects in Odisha. It was conveniently located within commuting distance of the more affluent and well-resourced coastal belt, with many of the transport connections, accommodation and amenities which were absent in rural central and western Odisha; presumably helpful to house the visitors to a 'showcase' micro-grid project. On arrival in the village, the micro-grid was one of the first things I saw, emblazoned with the logos of each of the participating organisations. This branding represented a moral economy within this relationship (Gardner, 2015), where the community member or any visitor was immediately informed of the 'benevolence' of the funders and implementors of this project.

I visited the village independently from the local NGO, after having spent weeks trying to organise a visit only to have them postpone it repeatedly. There was a lot of grey literature about the system available online, making it easy to find. This literature portrayed the system as a 'proof of concept' in community participation and 'appropriate' locally-embedded technology systems. They gave no indication that the system was out of action, but the micro-grid had been broken for several months. As it happened, all the micro-grids that had been installed as part of the project were in various states of disrepair. The man who had been appointed as the local operator of the system showed us around, saying, "It broke down months ago, we contacted [the NGO] to ask for it to be repaired, but no one has come." Along with the 10kW micro-grid, a small warehouse had been set up with a rice huller and other agricultural machinery, intended to provide an income to the community from the micro-grid beyond its household usage. I asked the micro-grid operator whether they missed the solar, he shrugged and said it did not make a difference to them. It seemed the micro-grid had not

functioned for long enough to be missed and he had a somewhat apathetic attitude towards it. It was unclear what had caused the breakdown, and the local operator did not know. According to the accounts of those in the village, no one had come to fix it and it was unclear if this was lack of funding or a lack of organisational incentive. I made subsequent efforts to follow up with the NGO, but they were left unanswered. It felt as though the system had been installed with great aplomb, but simply left to die. There was a distinct irony in the switch from micro-grids where communities were supposed to participate and become self-sufficient to an apparent abandonment once the projects broke down. Despite the rhetoric of 'community participation' in the projects, there was a distinct asymmetry when the installer appeared to default on their side of the arrangement. The NGO branding on the system had presumably been put there to hail the grand successes of the project but became as much an embarrassing reminder of its failure. The micro-grid had died a death simply through being abandoned by those implementing it.

I did not spend as long as I would have liked in Bhujanga, and so could not draw significant conclusions on how individuals in the community perceived the micro-grid system or drew meaning from it. The people I spoke to seemed largely apathetic; there seemed little evidence of the narratives of community mobilisation presented in the literature around the project. The Bhujanga micro-grid was far from the only one that had failed, though other NGOs were significantly more open about the challenges they had faced. When asked about this, most NGO staff seemed to have their own narratives of blame, which often focused on the changing nature of solar and shifts in how people in rural areas communicated. The programme officer at one of the larger NGOs saw his main issue as the communication between communities.

> *The problem now is that people have phones and things. You can install a system and get everyone agree to pay a certain amount and have a village committee to oversee it and that used to work well. The money would be raised to pay for repairs and replacements, so the donors would just pay for the initial costs. No donor wants to pay for repairs. But now everyone is installing solar. People can phone up their family in another village and find out that other people are getting the same thing but for a lower price, or for free. They no longer want to pay for it or put the effort in to make it work, they think they should get it free and delivered to them.*

For him, the blame seemed to primarily lie in the changing expectations and relationships between communities. The implication was that 'before' villages had been more isolated and accepting of external interventions, but now an increased knowledge of solar energy was resulting in a lack of commitment from local communities. It was notable that the same groups advocating for self-sufficient and 'empowered' communities were also blaming communities for what were, in effect, attempts to exercise agency in the micro-grid projects. This could be reframed; the processes of comparing pricing to neighbouring communities and using this as leverage was arguably a way of exercising agency over the systems and of deconstructing the developmental logics imposed with such systems. The programme officer did not question why donors did not want to pay for repairs or whether this should become an expectation in funding arrangements, instead laying blame with the behaviour of the communities that did not meet the exacting standards of his NGO. The subsequent failures of micro-grid projects were, in effect, caused by the dissonances in their expectations to those in the community. If these projects were then abandoned because of lack of funds for repair (either from the donor or from the communities themselves), this was ultimately because of the clashes in perspectives.

His reference to the expectation of getting solar energy for free was echoed in other conversations. An NGO worker from a different organisation went further, saying, "The government provision of free solar is making people beggars and building dependency on them. People need to understand their own capacities to get micro-grids to work." The idea that the state made people "beggars", while the NGOs made people "capable" was a powerful concept that seemed to run through many of the organisations I spoke to. This both politicised micro-grid projects, and provided a convenient narrative of blame that absolved the NGOs from accountability in the failure of their projects, even when, as in the case of Bhujanga, it appeared the NGO had abandoned the project and ultimately the community. It was also a powerful indication of how communities were 'cast' in a different role through how they were provisioned with electricity. The way in which NGOs evoked the 'government' and their provision of solar energy and the grid in many of the narratives around micro-grids highlighted the intersection between different actors and their engagements with off-grid energy.

6.3 Government

In terms of the number of projects and budget, OREDA, the state renewable energy department, was the largest actor in off-grid solar in Odisha. However, they garnered little of the media attention and buzz around private and social sector organisations working in the space. They mandated, funded and planned micro-grid projects within their portfolio of renewable energy projects, which included household energy provision in under-electrified areas, as well as the installation of solar pumps and solar back up for schools, hospitals and government buildings in rural areas. The projects were sent out for tender and then fulfilled by contractors working across the state. By many accounts, these processes were not without the bureaucracy and corruption often associated with state-run infrastructure projects in India (Shah, 2010; Gupta, 2012) and often the end results were notorious for being poor quality and ineffective, as demonstrated by much of the solar waste that was present in Urjapur (Kumar & Turner, 2020). However, beyond this, the way in which the state engaged with off-grid energy and micro-grids embodied many facets of the wider developmental politics in the state.[21]

In November, near the end of my fieldwork, I spent a week following up on referrals and leads I had accumulated throughout the year when asking about micro-grids in Odisha. I wanted to gauge the extent to which the experiences of those in Urjapur might be reflected elsewhere in the state. I decided to visit OREDA to see if any of latest tranche of state funded micro-grid projects, sent out for tender almost 10 months earlier, had come to fruition. I had low expectations; they seemed to be constantly delayed, postponed or cancelled.

My main contact in OREDA was a mid-level government official named Arvind. He had been introduced to me by a friend as one of the 'good' people in the state civil service; the ones who did not take bribes and were invested in the work they did for the government. These were also apparently the people who were rarely promoted and whose efforts were often thwarted by their reluctance to participate in the more illicit aspects of the agency's

[21] For context, Odisha state politics somewhat contrasts with the shifts in national politics in India, and gets little coverage on a national stage. The ruling Biju Janata Dal (BJD) party, led by Naveen Patnaik (son of state founder Biju Patnaik), has been in power since 2000, breaking off from the central BJP in 2009 over communal issues (Misra, 2009). While seen as being in opposition to the Congress Party, the BJD characterises itself as being secular, pro-poor and pro-development (Sahu, 2011). From conversations during fieldwork, some were critical of the party as being populist, corrupt and lethargic in its approach to governance but, by and large, they remain popular.

operations. However, Arvind seemed to have a genuine passion for his work and helpfully took an interest in my own project.

The OREDA offices were located in an industrial and rundown area of the city. They were composed of a motley group of unimposing, poorly maintained, single storey buildings; every time I visited, my taxi or auto driver would be concerned that I had the wrong address. The offices seemed a remarkable contrast to the hi-tech, modern image often associated with renewable energy. I had expected an extended wait outside the office, but instead was met by an excited Arvind, who led me straight to the office of Sailesh, the managing director of OREDA.

“She wants to look at micro-grids.” Arvind said, gesturing to me, “She should go and visit the UNDP [United Nations Development Project] micro-grids.”

Sailesh laughed, and said he had not thought about that project in a long time and did not know what the status of those micro-grids were.

Arvind said in response, “It would be interesting for her to go and check. She can report back to us. There is already all the information documented on the projects by UNDP. If she wants to see micro-grids, those ones were the first, it will be good for her project.”

His suggestion shed light on how they viewed me in this scenario. I was clearly seen as having some level of expertise or legitimacy in being able to ‘report’ on the systems, potentially augmented by my background and positionality (or perceived naivety in my willingness to go and visit their project sites).

I asked for clarification on what they were talking about.

“In 2002, we installed 15 micro-grids in collaboration with UNDP. It was part funded by UNDP and OREDA. They were all in tribal villages, backward places, mostly in Komna block. They were supposed to help establish livelihoods in those areas.” Sailesh said.[22]

“Most of them were solar, but some were biogas and one was biomass. The biomass one wasn’t effective though.” Arvind added. They both seemed to be enjoying reminiscing about the project. “UNDP were mostly funders; we did all the implementation. Tata installed the

[22] There is overlap with UNDP as an INGO. I count it as a government-installed system here primarily because it was OREDA who did the installation and because the scale of the project (15 villages) was unlike anything being undertaken by Indian or Odia NGOs. When I was there, OREDA did less work directly with INGOs, getting the majority of its funding through state and central government funding.

solar panels and agreed to service them for 10 years. This was ground-breaking at the time, no one was offering a 10 year warranty on solar. The project was very successful at first, it was the first of its type in India and gave rise to the MNRE [Ministry of New and Renewable Energy][23] remote village electrification policy. The learnings from one village in particular were documented and put online, you can read about the project more before you visit. There were lots of visitors to see the projects from India and abroad."

"The livelihoods were unsuccessful though. We had over-romantic ideas." Sailesh said, "We had ideas of them weaving silk scarfs and artisan crafts, but we eventually realised that petty shops, tailors and cycle repairs were more realistic though. We didn't know so much what we were doing then. We thought, these village men just hang around all day and don't do anything. We thought they were lazy and would have plenty of time to put into running a micro-grid and starting businesses. But they had other things they were doing. They farmed and looked after children. They were busy, they just didn't work on the same timetable as us. They had no time to be running a micro-grid or taking up whole new skills."

Arvind agreed. "It was a good proof of concept for the solar, but the biogas and biomass were failures. People had no interest in collecting the dung and running the systems. It was too hard to make the system fair, when different people had different numbers of cows."

"We shouldn't have been surprised. In my apartment block, if they expected people living there to organise and monitor the DG [diesel generator] set, they would never want to do it. No one wants to have to run their own electricity", Sailesh said.

"There's a grid psychology that's the same even in the villages without grid, it was too difficult to change. People just want electricity; they don't want to take responsibility for it." Arvind commented. They both seemed thoughtful, much more understanding than judgemental. It seemed the experience had been a learning experience for them in how they related to people living in villages.

"How long did they work for?", I asked.

"We don't know, I don't think anyone monitored them. It would be good actually for you to go, tell us what's happening." Sailesh said.

[23] MNRE is the central Indian ministry which governs off-grid energy, which has some involvement with state level planning and funding for solar micro-grid projects, though many states have started to develop their own micro-grid policies (Ahmad & Alam, 2018).

As I was leaving, Arvind said, “You shouldn’t quote us on this though, it will make OREDA look bad.”

Sailesh laughed and said, “It’s okay, she can. It was a long time ago and these are all learnings. Some of them we still haven’t learnt from.”

The meeting left me feeling intrigued about the project, but also interested in how Sailesh and Arvind spoke about it. Much like Anshuman and Santosh with the SolarFuture micro-grid and the NGO implementors, they, presumably along with others on the project, had created an initial idea of what their micro-grids should achieve and how they should ‘develop’ people. This seemed to stem from very specific notions of who these people were, such as being ‘lazy village men sitting around’, amongst other things, which they both admitted were flawed. Their subsequent re-evaluation of the people in these villages was largely undertaken through the lens of the technology and seemed to be reformulated with a level of understanding with the perspectives and logics of the communities themselves. There was potentially a similarity in Arvind’s point around taking responsibility to the conclusions drawn by the NGO staff, in a potential resistance to people taking on the work it took to keep a biogas or biomass system running. However, instead of this being framed as a failing of the community, both men drew parallels with their own lives and acknowledged a potential burden on communities having to take responsibility for the micro-grids.

On my way out, I asked Sailesh’s assistant to give me details of the villages where the project had been installed. I was handed a single piece of paper with a table of the village name, type of micro-grid and number of houses. Though Anshuman had said they were all in Komna block, they seemed to be spread across western Odisha.

On a Sunday afternoon two weeks later, I found myself in the back of a taxi travelling from Balangir town to what I hoped was one of the UNDP micro-grid villages. It had been quite a journey. With a friend from Bhubaneswar, I had spent the last 2 days travelling around the state attempting to find the villages listed in the OREDA documentation, with little luck. No one had heard of them and they did not register on Google Maps. Multiple villages seemed to share the same names and we had no way of knowing which one might be the one with the micro-grid; not least because the project had been installed over 15 years ago. Most of the micro-grids seemed to be labelled as the name of the hamlet within the village, not as the larger village listed as Gram Panchayats on block level listings. We were close to giving up.

It was difficult to identify which villages had the specific UNDP micro-grids because every village had copious amounts of solar PV installed. We would arrive in a village (seemingly with the correct name) and ask if it there was a solar micro-grid. Upon hearing "solar", we would inevitably be pointed towards a solar pump in a school, solar streetlamps along the road or a bank of solar lanterns to be rented out as part of the 'Light a Billion Lives' (LABL) project. Most would be accompanied with signage showing who had installed them within which project, ranging from government projects to CSR donations or NGO interventions. We were drawn into numerous intense debates about people's frustrations with them and the politics around them. One man complained, "Why is there no streetlamp outside my house? We're important in the community, we should have one." Another group of young men complained at length about the breakdown of the solar pump in the school and one woman brought a solar lantern from her house and asked us to compare it with the grid access of her neighbours. There were no signs of any micro-grids. While frustrating, these conversations emphasised the nature of the debates about solar energy and electrification had on a local level, far removed from the discourses at high level institutions. While the Urjapur micro-grid was, in many ways, new and different to other solar innovations, the contentions around it were reflected on a much wider level. People still discussed when, where and what had been provided, solar PV was still dragged into the contentions around caste and status and people still compared it to the grid. Solar energy, in its various forms and iterations, either functioning or broken, was part of the furniture of rural Odia villages. This made a striking contrast to the more charismatic representations of solar micro-grids in NGO grey literature and in marketing material from organisations like SolarFuture.

We eventually decided to make one final attempt at finding one of the UNDP micro-grids. The taxi driver stopped at every village we passed through to ask if people recognised the name of the village, we thought we were closest to, Meragada, and if anyone knew about a solar micro-grid. After several hours, we stopped on the main road and flagged down an older man riding a bicycle. We asked about solar, and he immediately lit up, replied with the English "micro-grid?".

Following his rickety bicycle up the road, we eventually came to a reservoir at the bottom of the hill. The man pointed up the hill and said it was Meragada. We walked along the dam to a hamlet of not more than 40 houses. There were grid lines running to the village, but in the central area there was a small *pucca* building, on top of which was an array of dusty solar

Figure 8: Meragada micro-grid.

panels (see figure 8). Finally, we had found one of the micro-grids. There were not many people around, but a man came out of his house to talk to us. He seemed unsurprised by our visit, though it looked like it had been a long time since the micro-grid had been paid much attention. He showed us into the building where there was an array of lead acid batteries, looking somewhat worse for wear. There were bats in the roof and it was clear the system was no longer operating.

“It was installed 20 years ago, I was 15. We had a village council who ran it. People used TVs, fans, radios and lights. It stopped working two years ago.”

I was extremely surprised that the micro-grid could have survived for so long; it had been implicit in the conversations with Arvind and Sailesh that the micro-grids would be long defunct. Other than Urjapur, all the micro-grid sites I had visited in Odisha had been in some state of disrepair. That this grid functioned for 18 years, eight of them outside of warranty, was astonishing.

We asked what had happened.

“We used to run the system with a committee, everyone paid money into a shared kitty. We changed the batteries, from the money that everyone contributed. But when the grid came people stopped paying and we could not fix it.”

“When did the grid come?”, I asked

“It came two years ago, but just for families with BPL cards. They pay 160rs per month but can only use 2 lightbulbs on it. It’s more expensive than the solar was. The people connected to the grid stopped paying for the micro-grid and eventually it broke and we couldn’t repair it. It’s a shame… With the solar we could choose when we switched it on and off, now the grid only comes for a few hours a day and it’s unpredictable.”

By this point, I was amazed. Not only was it remarkable that the system had worked for so long, but it had worked using a community model which seemed to fail in so many other places. Until that point, I had yet to hear anyone say they preferred the solar energy over the grid energy.

“Is everyone here BPL?”

“Everyone is, but only some families have the BPL card, so only they have the connection. We’re trying to get the card so we can get a connection. Without the solar we have no electricity.”

“Were there any livelihoods dependent on the grid? Like shops or tailoring businesses?”

“No, people only used it in their houses, everyone here just does farming.”

I asked about the Tata warranty on the system, but he said that he did not know and the people who had been more involved in the system were away from the village that day.

The man’s mother came out of her and sat with us. We asked her what she remembered about the micro-grid being installed.

“When the system was installed no one knew anything about solar, it was exciting. We agreed immediately. We knew that other solar had been installed in places further away, but no one nearby had it. Now you see solar everywhere.” Her son nodded in agreement.

She continued, “Before this there were elephants that came this way and destroyed houses, when we got the lights, they stopped coming so it was safer. We weren’t so afraid of house

fires from kerosene lamps." She gestured the thatched roofs of the *kutcha* houses in the village. I had heard similar accounts of both elephant rampages and kerosene fires in Urjapur.

We never managed to visit the other villages on the list of UNDP micro-grids; most seemed to be further in the hills on the Chhattisgarh-Odisha border. It could be entirely possible that those micro-grids had been very different and collectively would all make compelling sites for understanding the legacies of micro-grids. However, it had taken so long to find Meragada that we had to leave soon after to catch a train back to Bhubaneswar, having only spent a short time in the village. The micro-grid project stuck with me long after I left fieldwork. In many ways, it was unremarkable; it was a fairly low capacity system and had none of the flashiness of the Urjapur micro-grid. It had not been transformational for life in the village in the way the OREDA and UNDP implementors had imagined it might and, in most ways, the village was remarkably similar to the many others we had dropped into on our way there. There were no businesses or livelihoods that had been catalysed by the electricity provided through the micro-grid. However, the micro-grid clearly had made an impact in the community. It was useful enough for them to keep it running collectively for 18 years, including buying replacement parts for it. At least some in the community still missed it even after it had broken. The excitement they described when they first got the system was far from the disillusioned responses to solar energy project now; it had been new, exciting and special to their community. Unlike so many villages, where solar PV was almost synonymous with breakdown and maintenance issues, the micro-grid here had functioned, at least as technically, as planned. It seemed remarkable that, despite the OREDA and UNDP approach of installing the projects and quite literally forgetting where they were, the technology and the structures around it had continued to function.

It was unclear what conditions had enabled this project to continue functioning, when so many others across the state had failed. However, ultimately the micro-grid's life had come to an end because of the extension of the main grid. Although the provision of the grid was more limited than the micro-grid, it had still displaced it. The death of the Meragada micro-grid after being usurped by the main grid indicated a hierarchy in energy provision and an obsolescence of the technology once it intersected with the main grid. This grid was effectively in competition with the micro-grid, and the micro-grid did not win, despite having had a long and successful life.

The Meragada project embodied many of the typical characteristics of government-installed micro-grids. The projects had been installed, seemingly with ambitious aims, but little long term foresight beyond the provision of a warranty. The government had forgotten where they had put them, a stark contrast to the 24/7 remote monitoring which took place with the Urjapur micro-grid, where its longevity was central to its operating structure. Arvind and Sailesh were candid when discussing their failings on the project and in developing livelihoods, but even this seemed to be more effort put into project design than usual within government projects; most projects had little provision for livelihood development within them or for any interaction with local communities in running the systems and instead prioritised replicability in large scale tenders. By and large, it seemed that the majority of government provided grids were likely to die from being abandoned or from competing with grid, which was evidenced by numerous broken down projects, including the micro-grid in Karada, the village near Urjapur that I had tried to visit (see chapter 5).

However, little in the government model required them to have long lives. They formed part of government mandates for rural electrification (Palit & Malhotra, 2015), but often as a stop-gap until the grid could be extended, in which case being overtaken by the grid was positive outcome. They were important in meeting renewable energy targets, but with little accountability for their long term functioning. As was explored at the end of chapter 4, the were effectively micro-economies in failed solar projects which would get renewed replacements every few years. Contractors and government employees alike benefitted from projects which would need regularly replaced. NGO staff criticised the way in which the provision of off-grid energy solutions aligned with electoral politics, saying that it was not unusual for solar lanterns, streetlamps and pumps to be handed out liberally in the lead up to elections. If government projects came with a fee collection structure, this was rarely followed through; in Urjapur the OREDA provided home light systems were effectively free. Their operating model depended on financing from state and central government budgets, which included in them generous allowances for renewable energy (Kapoor, et al., 2014), but within the wider scales of state budgets presumably got lost.

6.4 Enterprise

In discussions in Bhubaneswar, the private sector, marketized micro-grid model was often mentioned but rarely materialised (Heynen, et al., 2019a). Broadly speaking, this was the sector within which the SolarFuture micro-grid fell, though with key nuances. Enterprise

models for micro-grids have become established in North Indian states more than anywhere else in India (Urpelainen, 2014; D'Agostino, et al., 2016; Singh, 2016). Often touted as a type of 'social enterprise' (Tonia & Houndonougbo, 2016), the underlying logic was that electricity provision to the unelectrified and under-electrified could be fulfilled through market models. This implied a win-win scenario, where companies could provide solar energy through networked systems and where consumer's energy demands could be met through 'clean' energy provision. Particularly compared to the NGO provision of micro-grids, private sector models were seen as being more 'sustainable' long term and less reliant on donors (Jolly, et al., 2012), but with the ability to bypass perceived corrupt and inefficient state provision (Balls & Fischer, 2019). Many of these models drew directly from the C. K. Prahalad "bottom-of-the-pyramid" (BoP) approach to marketing (Prahalad, 2004), whereby changes in the operating structure could position even the poorest communities as consumers (Scott, 2017), shifting their relationship with energy providers from citizens or beneficiaries to customers. There are problematic elements within the BoP approach, not least its potential to be both ineffective and exploitative (Karnani, 2007); however, in the off-grid energy sector in India, it was seen to be central to establishing financially 'sustainable' mechanisms for disseminating solar energy (Cross, 2019c).

I spoke to numerous entrepreneurs planning micro-grid projects in Odisha, who were planning to install micro-grids and then recuperate the costs through payments by their users. There were successful companies who did utilise this model working in West Bengal, Uttar Pradesh, Bihar and even neighbouring Jharkhand (Krithika & Palit, 2013; Urpelainen, 2014; Singh, 2016). While there were 'social enterprises' selling other solar products in Odisha (Cross, 2019b), the model for micro-grids had not gained traction. A programme officer working at an Odisha based NGO provided his explanation for this, saying:

> *Odisha is a hotbed for pilot projects, everyone wants their proof of concept here. It has a poor economic status and lots of social issues, so it's easy to raise funds for pilot projects and one-off interventions. Many international aid agencies have Odisha, particularly the KBK [Kalahandi-Balangir-Koraput] area,[24] on their list for states to prioritise in development funding. People use micro-grids as a showcase to raise money for more projects. They bring in visitors to see them, but when it comes to implementing*

[24] The region of western Odisha encompassing Kalahandi, Balangir and Koraput districts has long been known for high levels of poverty, and has been the recipient of significant quantities of aid and development funding (Panda, 2016).

more, these can be technically unviable. You don't see the large scale business models around micro-grids that you see in North India. In Odisha people are too poor, MGP [Mera Gaon power][25] would never work here, it's financially unsustainable, they won't make a profit.

The owner of a small solar business operating in Koraput, in Western Odisha, explained the barriers to installing commercially operated micro-grids in his region:

The geographies are too difficult. In Uttar Pradesh, there aren't the same hills and forest cover. It's quicker and easier to connect entire villages. Here the off-grid villages are tribal, you have to trek through the forest and it's difficult to install anything. Even then, you need a translator for the tribal languages and more time to gain the trust of the community.

Some of these comments were echoed in conversations around the Urjapur micro-grid. Santosh, the operations manager, said, during a moment of frustration, "If we can make it work in Urjapur we can make it work anywhere. It has every issue imaginable, it's a good proof of concept."

These explanations shed light on how the challenges of micro-grids were perceived, but did not fully explain why the model had not taken off. The idea that people were 'too poor' challenged the logics of the 'fortune at the bottom of the pyramid', which argues that even the poorest of people could be serviced through the correct delivery model (Prahalad, 2004). It did, however, support the alternative NGO approaches to micro-grids. The geography of the state may well have been a barrier, but many of the justifications for micro-grids were that they could be installed in those very contexts (Bushan & Kumar, 2012). This is not to say that their perspectives were invalid, but it seemed that many of the logics driving enterprise driven micro-grids failed to fully cohere.

Anshuman also had his own logic to explain the difficulties of operating a commercially successful micro-grid model in Odisha, particularly persuading people to pay for the provision of solar energy. He did not entirely support the BoP micro-grids logics. His model used corporate social responsibility (CSR) contributions to cover the capital costs of his systems, and only required the community to pay enough to sustain the systems, reducing the costs

[25] One of the most prominent micro-grid companies operating in the North India (Palit & Malhotra, 2015).

significantly. He did, however, still see the micro-grid as generating electricity that could be sold as a utility.

> *The worth of solar has decreased. People get given it for free, they don't see it as something to pay for anymore. The market for it has been ruined. This is largely the government who do this.*

He directly referenced the proliferation of OREDA and forest office home light systems in Urjapur. There were parallels with the way in which NGOs blamed the government for 'ruining' the localised capabilities. However, from my conversations and interactions in Urjapur, it seemed that there was a fundamental mismatch to the 'marketized' value placed on solar by implementors and the value drawn from it by its users. Anshuman was frustrated at the reticence of the community to pay for the energy from the micro-grid, the cost of which he had derived from estimations of upkeep and replacement costs. By contrast, the community were making judgements on what to pay based on the value they took from the system, which was very different. They compared the cost of using the micro-grid with the subsidised cost of main grid in other villages, with using solar energy from other devices provided for free and even with kerosene rations. Government subsidies were, indeed, warping 'market'-driven pricing of electricity, but community decisions on what to pay for were based on the options that were offered to them. Those who advocated a marketized version of solar micro-grid also needed to acknowledge the competition they faced in providing energy and the agency of communities in making decisions in what they engaged with, even if this did not overlap with Anshuman's plan for the micro-grid.

His idea of the worth of solar having decreased, however, engaged with the disillusionment about solar energy that was apparent in many places. Near the end of fieldwork, I finally managed to visit Karada, the village with the failed micro-grid where I had been denied access to by the DFO (see chapter 5). A consultant from a Delhi-based 'green capital' consultancy firm was visiting Urjapur as part of a research project advising venture capitalists interested in investing in the micro-grid market. Anshuman organised for one of the forest officers to take her to Karada, to get the perspectives of those who had experienced failed micro-grid projects, and I was able to accompany them. While there, she interviewed numerous community members on their opinions on solar energy and micro-grids, keen to provide insight to potential investors.

There had been many iterations of solar installations in the village, including the infamous AC micro-grid implemented by OREDA. It had been overloaded when too many appliances were attached to it. In response to its breakdown, the community vandalised the infrastructure, removing the panels and batteries to leave only the empty metal frames. The whole village was a graveyard for solar goods, with each house having 4 or 5 solar panels from iterations of solar home systems installed by the government and several NGOs. There was palpable anger about these solar failures and a reticence to even discuss them, more so than in any other village I had visited. Most people had reverted to using kerosene *dibri* lamps. One young man was particularly vocal, complaining loudly: "We would never be prepared to pay anything for solar, it does not work. We're fed up of all the solar. We want grid power or nothing."

The consultant asked him if he had heard of micro-grid projects in other states that were working well, keen to promote the projects she was garnering investment for. He replied that he did not care and that he had seen enough in Karada about the failure of solar. This point-blank rejection of micro-grids was not conditional on any payment or perceived monetary value in solar energy. He clearly had no interest in the 'self-sustaining' narratives of micro-grids or of being a potential customer to a new project. The 'worth' of solar had indeed decreased, but it was not because it had been provided for free but because of a disillusionment in the technology (Mirza, 2015). It seemed that this disillusionment would undermine any potential future efforts to install a micro-grid there.

6.5 Conclusion

The micro-grid sector in Odisha was a diverse place, with a range of values, politics and ideologies being placed into and enacted through the technology. For NGOs, micro-grids were seen as a potential avenue to self-sustaining communities, free of dependencies on a corrupt and bureaucratic state. They were not just about providing clean energy, but part of redefining the nature of rural villages. For the government, they were a stop gap for providing rural electrification and a way to fulfil election mandates and placate frustrated citizens. They were also effectively disposable, with little accountability for their long term functionality. For businesses, micro-grids were a way to fill a gap in the market and to make a sustainable profit while efficiently providing clean energy to rural communities. They were also a way to bypass the state but by framing users as potential customers as opposed to beneficiaries. In many ways, these perspectives are not unique to the provision of micro-grids. They align with

some of the most fundamental development debates taking place in India since independence (Drèze & Sen, 2013), and resonate across South Asia and the global south more widely. They represent many of the contentions between the provision of resources, opportunities and facilities by the state, the market and the NGO sector as well as conceptualisations of who and what constitutes a 'modern' rural India. The micro-grids (and the assemblages around them) acted as attempts to embody and enact the politics and ideologies of those designing and implementing them, as well as a lens through which the users were cast in different roles in reflection of these. The way in which various implementing actors attempted to do this spoke to a version of appropriation, or *jogad*, where the micro-grid technologies were appropriated as vehicles for specific politics and developmental agendas.

A commonality across all of them, however, was the low levels of 'success' in implementing their models. It became apparent across fieldwork that the presence of 'dead' micro-grids across the state was indicative of fundamental issues in how they were conceptualised and implemented, and the dissonances that existed between how micro-grids were perceived by those designing them and the realities of the communities they were placed in. Blame for these failures was placed on each other, for instance, in terms of Anshuman's 'ruined' solar markets or the government making people 'beggars', or on communities for failing to live up to the exacting standards of the micro-grid's operational structures. There was rarely an acknowledgement of the agency of the communities involved. Indeed, it was only Sailesh and Arvind in OREDA who actively deconstructed their own expectations with reference to user communities.

The different ways that micro-grids failed across the state, through being abandoned, outcompeted by grid or through disillusioned users (and overlapping combinations of these), were perhaps inevitable outcomes of the failures of these models. They were some of the key ways in which the assemblage of ideologies and technologies were deconstructed and undermined, and the point at which the assumptions of who the users were clashed with the realities of how they perceived themselves. In NGO micro-grids, such as the Bhujanga system, systems for repair and maintenance hinged on communities taking on responsibility for them; if they did not, they were almost inevitably abandoned. This applied to many of the government provided models. Where aggressive grid extension was taking place across India, there was also an inevitability that micro-grids would become irrelevant and outcompeted.

In a context where communities had been overloaded with solar objects, it seemed that the allure of solar energy had been lost; engaging communities in paying for and participating in micro-grids seemed like an overwhelmingly uphill battle. It was only the Meragada micro-grid which shed a glimmer of hope of micro-grids 'working' in Odisha and 'working' for communities. I could only speculate about why this project had succeeded where so many others had failed, but it had been installed at a point where it had been new and exciting to the community and where the promise of grid was almost non-existent. The community had taken it on in the exact ways that the NGOs aspired to, and so had maintained and repaired it. Ironically, it was the only 'proof of concept' that I found that micro-grids had any potential to be successful in Odisha, but the implementors did not even know this. It was still far from an assurance that they had widespread appeal.

Disillusionment in many ways seemed to be the biggest 'risk' to the Urjapur micro-grid. The 'smart' component of the micro-grid meant it was far from being abandoned, with real time monitoring at all times. Its position inside the tiger reserve meant that it was (at that point) 'safe' from competition from the grid, though still had competition from other solar home light systems and kerosene. However, while the overall model for it had captured the attention of funders, media and competitors, it had, by and large, failed to inspire and excite the community (Mirza, 2015). This was arguably where the system was most vulnerable. Tt bred discontent and failed to enrapture the community. The next chapter explores the dynamic between the charisma and disillusionment in the Urjapur micro-grid.

7. ‘Smart’ Charisma and Disillusionment

7.1 Introduction

The previous chapter explored the landscape of micro-grids across Odisha. Across the state, I was struck by frequency with which micro-grid projects appeared to have ‘failed’ and the extent to which their users were uninspired, apathetic and disillusioned with the technology. Far from the image of the hi-tech, transformative technologies that are presented in conferences on renewable energy, in academic literature and the marketing materials for such projects, micro-grid projects seemed to be precarious and fragile, and doomed to underachieve on their ambitious targets. This builds on my understandings of the Urjapur micro-grid, which was constantly being deconstructed and reassembled by its users and in a continuous tug-of-war between the visions of its designers and realities of its users. This chapter asks how, in the face of so many challenges, failures in logic and attempts to deconstruct the micro-grid assemblage, does the assemblage persevere and continue to adhere? It seeks to interrogate what it was about the ‘smart’ micro-grid concept that enraptured not only the engineers working on it, but the network of funders, supporters and surrounding media who helped to propel it, while still failing to resonate with the Urjapur community. It utilises the concept of charisma, as a counterpoint to the disillusionment around the micro-grid, to understand how the assemblage continued to cohere. It argues that this charisma served to conceal less palatable underlying politics associated with the micro-grid and was constructed in direct contrast to more localised forms of charisma and influence. This chapter particularly focuses on the ‘smartness’ within the SolarFuture micro-grid, seeking to challenge how this term was used and propose more localised alternative configurations.

In order to understand more of the ‘back-end’ processes (both technical and social) of the SolarFuture micro-grid, I spent a month at the ‘control room’, which was based at an engineering university campus in Berhampur, a town about 100km down the coast from Bhubaneswar. My observations and conversations from this period were central to shaping my understanding of how the micro-grid was viewed by the engineers who built it and who had commitments to the ideologies and futures that it proposed. During my time there, I

observed the operations of the software team responsible for monitoring the Urjapur smart grid and spoke to many of the students and staff members at the university who had been involved in the project. The campus had its own version of the smart system used in the Urjapur micro-grid, acting as a testing ground for key components and providing parts of the university with solar power, using kitchen waste to generate biogas and piloting small scale agricultural projects. The scale of the work at the campus was indicative of the commitment both to Anshuman's vision for SolarFuture and to the wider movements towards the deployment of clean energy and data-led solutions for rural applications.

Soon after I arrived at the campus, Girish, a software engineer in the SolarFuture team, walked me through the back-end software interface for the micro-grid system.

> *This interface is the control panel for the remote management system. The cloud based system allows us to monitor local parameters, such as environmental conditions, water consumption and energy consumption. We can also control our systems from here. The control panel is split into subsections, some of which can be seen only be the administration here, some by middle operators and, if necessary, some by the end users. They cover the metering and billing platforms, service and maintenance and overall system health. We have multiple different sites, including the campus here. Most are commercial; Urjapur is the first smart village.*

He flicked to a map of the village.

> *The most commonly used section is the customer desk. Here, connections can be added and taken away. They can be scheduled by hour, usually for the full week. Each individual outlet is controlled. We can switch them on and off from here.*

He clicked through the interface to show me graphs showing the real-time consumption patterns of the Urjapur micro-grid.

> *Here we can see the technical parameters for the system. We can monitor voltage, power and current across the grid. It's been most helpful to understand the leakages from faults in the system, so we can identify any issues quickly and resolve them. It can also be used to look at behavioural aspects, such as lights being switched on. Using the software allows the comparison of the actual generation versus the expected generation, so we can check the functioning of the system. We've had to deactivate members of the community, because they did not give payment or attempted to use*

excess power. All the smart meters are in locked distribution boxes, not in the houses, because it reduces the chances of tampering.

His explanation carried implications about the inner workings of the system. The system embodied constant surveillance of its users, where some were cast as 'good' users, who paid on time, used only the energy they were entitled to and made no attempts to 'tamper' with the distribution systems. Those who were not would have their access cut off. Though from a distance, the micro-grid engineers attempted to stamp their authority on the community. This, apparently, was what constituted the 'smart' system.

He went on to describe some of the future design elements they were planning for the micro-grid, in Urjapur or elsewhere. These included photo or voice recorded consumer complaints, bypassing the issue of illiteracy and language barriers, and consumer apps to check and pay bills. The inclusion of environmental monitoring for temperature, humidity and soil acidity would enable 'smart' agriculture, in conjunction with remote-operated drip irrigation feeds. This was a stark contrast to the more *jogad* methods of farming explored in chapter 3, where paddy farming was often done to maximise the forest office compensation for animal damage, rather than to maximise agricultural production.

The scheduling aspect of the customer desk is all done from here. Currently, it's most relevant for things like the irrigation pumps, where the farmers are informed verbally of the schedule before it is implemented, and can then work around it. Potential community members wishing to set up new businesses need to consult with the operator, who can talk to us to schedule their power requirement. If power is needed outside of this scheduling, it will not work.

"What were the challenges in the system?", I asked.

It was the first project I, or any of us, had worked on in a village, so it presented challenges. At first, the community were not prepared to adopt the system, they needed time to understand what the micro-grid was and we needed to understand what the community required. It took 3 or 4 months to get them fully on board. We anticipated the problem of maintenance, that's why the smart components were important. The local server to the cloud was important too, but expensive, since the village has no phone reception. Most other issues we've been able to work around, but it's been trial and error.

I asked if, in his opinion, the system was achieving all it had set out to.

> *We've already seen progress. Some enterprises have been aided by the micro-grid, like the kirana shop which now uses electricity to operate a fridge and sell cold goods. But one of the biggest changes is what people do with their time. Before the community would simply work in the day and have dinner and sleep in the evening. This has changed, we can see. With TVs, radios, fridges and other electronic items the lifestyles are changing.*

The 'smart' system measured minute details in the technical parameters of the system, but there had been no formal monitoring or evaluation of the project's impacts in the community. Any understanding of its impact had been derived from technical system diagnostics, anecdotal evidence from infrequent visits and the information they could extrapolate from the 'smart' data they collected (from which Girish had noticed the changes in people's behaviours). These were by no means insignificant sources of data, but there had been no efforts to systematically analyse these at that point and, without greater dialogue with the community, there were a multitude of ways in which these could also be misconstrued and things that the 'smart' data could not see (Brooks, 2013; Kitchin, 2014). However, there was an appetite for understanding the developmental impacts of the micro-grid and Anshuman said repeatedly that they wanted to undertake an impact evaluation of the micro-grid. He wanted to frame this around metrics for community wellbeing, and I got the strong impression that he was hoping I would undertake this (clearly, I did not). As he put it, he wanted to "prove" the success of the micro-grid. However, at this point, outside the community themselves (and, to a certain extent Subhra and me), everyone else involved in the Urjapur micro-grid had remarkably little insight into how the micro-grid was being experienced in the community.

"How does the smart system specifically enable this? Is it different to micro-grids without this?" I asked.

> *The main advantage of the smart system and interface is the monitoring aspect. Hardware engineers visit the system about once every six months, or whenever there's an issue. But the software engineers only visited once to install the system, we can do everything remotely. Smart technology is the only way to make these projects truly sustainable.*

From what I could tell, however, the 'smart' system was achieving much more than simply monitoring the system health. Instead it was implementing mechanisms by which the community had to ask permission before using energy for certain things and where the engineers adjudicated on whether these should be supplied with energy. It was rendering a greater control over the outcomes of the micro-grid. However, as was explored in chapter 4, this was also being resisted and undermined within the community.

The engineers on the campus were developing deeply technocentric visions of rural futures. They were attempting to develop cutting edge technology on the campus that could transform rural communities. They took on the attitude of Silicon Valley entrepreneurs, where innovation, product development and tech-centred problem solving could remedy even the most complex and imposing developmental challenges (Kenny & Sandefur, 2013). The place was buzzing with excitement about the potential for applications of the 'Internet of Things' (IoT) revolution in the most remote corners of India.

As well as the staff working on the project for SolarFuture, I also spoke to many of the students who had been involved in developing 'smart', IoT projects for applications in rural areas. Most were lower middle class and, although few came from villages themselves, most had ancestral homes and family links in rural areas and came from the towns and small cities of Odisha, Andhra Pradesh and Jharkhand. Many aspired to move to the large tech hubs of Hyderabad and Bangalore in future, but they had a familiarity with rural contexts. The students I spoke to were passionate about the projects and were happy to show me around. Many had helped to undertake preliminary research for SolarFuture and recounted their experiences visiting the villages across the state to understand the landscape for potential micro-grid projects. They said they were excited by the idea that their engineering knowledge could make a difference. I could relate to this, having been part of UK-based NGO *Engineers without Borders* during my own undergraduate mechanical engineering degree, and was also keen to find ways that engineering could be used for 'social good', as opposed to working for large, faceless corporations. The students were not unaware of the social and cultural contexts into which the technology they worked on would fit (potentially more so than some of their teachers) saying explicitly "from the visits we did, the cultural and social aspects were a lot more important than the technological developments". Many of the male students said that they would like to work for an organisation like SolarFuture after they graduated, rejecting placements in the large tech companies which recruited directly from the campus.

The expectations of the students involved in the project were tempered with the realities of their own lives, including familial pressures and gendered expectations. A second year female student drew me aside one evening, saying "I would love to work on these things, it seems more worthwhile than working in a large international company which never benefits regular people. But my parents are strict, they want me to get married as soon as I graduate. Living in the campus and working on this project is the most freedom I will get. They wouldn't want me travelling for work, especially in rural areas. If I was going to get a job it would have to be in TCS or Infosys, so I could stay in a hostel in a city." The expectations placed on young female engineers and their absence in project design at a higher level created marked gendered 'scripts' within the micro-grid design, which are explored in detail in chapter 8. However, the aims, expectations and limitations on the young engineers were indicative of the subjectivities of many involved in the micro-grid project. While the project ethos was heavily technocentric, it often seemed to be the more personal commitments of the engineers which motivated their involvement.

On visiting the campus, it was easy to get swept away by the excitement around the smart grid project; indeed, SolarFuture visitors were often whisked around the control room and given presentations on the smart capacities prior to visiting the Urjapur site. But there were also other sides to campus life and late night conversations with students staying with me in the girls' hostel also revealed a darker side of the institution. Restrictive curfews for female students, even within the campus limits, were the norm, with the heavy metal gates being drawn across the hostel entrance at 6pm. Meals were served inside the hostel. Any students outside could be penalised or their parents contacted. Male students had free range of the campus at all times. Students in the hostel complained to me about cases of sexual harassment from members of staff, including one working on the SolarFuture project, and about their concerns in reporting it, lest it impact their grades and future employment opportunities. In recent years there had been student suicides on campus, and at one point rivalries between year groups in the boys' hostel had escalated to campus-wide unrest, with the military police being deployed to the campus to maintain order. The final chapter will explore to a greater extent how these contributed to the construction of the technology within this setting, but the 'dark' side of campus life seemed somewhat akin to the less palatable aspects of the micro-grid project; a messiness that remained unacknowledged in the polished image of the system operation.

I had numerous conversations with the staff involved in the SolarFuture project. For the most part, they shared a commitment to the ideas and vision put forward by it. The head of the technical operations for the micro-grid on the campus, Satyabrata, provided additional detail on the wider concept and the preliminary work that he and the students had done in researching micro-grid in Odisha.

> *We visited 10-15 villages, including ones which were on-grid and off-grid and where they had micro-grids that were or weren't functioning. We wanted to see the main problems, it seemed that these projects would get installed and then after one year they would be broken. There was no sense of ownership from the communities and the implementing organisations would just leave.*

This echoed my own experiences of visiting micro-grids across the state, where abandonment was often the death of such projects.

> *For our own project the biggest issues were the lightning strikes, which happened twice. They cost at least Rs 20-25k in damage each time, now we protect all our equipment, but it was a technical learning experience.*

It was striking the extent to which the engineers responsible for the software of the system were able to separate themselves from the ongoing tensions in the village around the micro-grid. There was a clear demarcation where the software engineers did not see, for instance, the refusal of people to pay for the system as their issue. I asked Satyabrata what it was that had made him personally so invested in the project. He seemed surprised by the question and thought for a minute before he gave answer.

> *I was inspired by Anshuman and his vision. I liked that the technology we work on could be used to make a difference. I enjoy the work; I think Anshuman's is a shared dream now.*

An impressive amount of technological research and development had gone into the smart grid, alongside an investment of time, energy, money and willpower. It had required significant commitment and determination from the community of engineers to make the project function. However, it seemed to be something of an uphill battle; from the lightning strikes, fires and literacy barriers discussed in the campus, to the arguments within the community and betrayals by government officers, alongside the constant negotiations and renegotiations with the community about pricing and control. Any of these events could set

the project back months, costs hundreds of thousands of rupees and potentially jeopardise the whole project. When things went wrong, it must have been devastating. The effort in assembling the constituent parts to make a micro-grid function was a huge undertaking, requiring the alignment and engagement of numerous different actors, technological design and capability and large investment. As seen in the previous chapter from cases around Odisha, despite everything, these efforts seemed more often than not to result in the 'death' of the micro-grid.

The question that struck me was simply, why? In the face of so much adversity, resistance and challenges to installing micro-grids, how did so much commitment to the success of this project remain? And how had this commitment to success, without any convincing promise of its realisation, translated into high profile awards, national and international media coverage and funding for multiple follow up projects across India? There was a bizarre coherence in the micro-grid assemblage where, despite missing the engagement of its core users and its near-constant critique and negotiation by the Urjapur community, the wider assemblage persisted.

The concept of charisma is helpful to understand the momentum carried by the technologies and futures of the micro-gird. In her analysis of the One Laptop per Child project, Morgan Ames frames the captivation, fascination and devotion that technologies inspire as charisma (Ames, 2015), drawing on Weber's theory of charismatic authority (Weber, 1947) and exploring how this charisma is built through ideology. 'Charisma' as a concept is not universal and is relevant within specific contextual configurations, with different applicability in different spaces (Friedland, 1964). Here, I use the term to describe the different effects of people's status, networks and education alongside the capacity to bring about different investments in renewable energy. I argue it acts as a force to adhere the narratives around renewable energy and digital technologies within the context of the Indian off-grid sector.

Particularly in development spheres in India, solar PV technology has arguably become a 'charismatic' technology. It follows a legacy of other technological developments that have mobilised important social, cultural and economic change and which have captivated users, politicians and leaders, development professionals and academics. For instance, technologies associated with the *Swadeshi* movement, most famously the *charka* (spinning wheel), played key roles in articulating the aims the Indian Independence movement and in laying the foundations for post-Independence India (Arnold, 2013). In the 1960s,

technologies associated with the Green Revolution, particularly in Punjab changed entire rural economies and ways of life, with unprecedented wider implications (Shiva, 2016), gaining both wide scale applause as well as condemnation. The rise of the cheap mobile phone in the 2000s also revolutionised life across India, changing how people communicated and accessed information and fundamentally shifting how society was organised (Jeffrey & Doron, 2013). I do not suggest that off-grid solar has had the comparative wide-reaching, transformational impacts of mobile phones. However, many in the off-grid energy sector have become captivated by the idea that solar PV energy could have such transformative potential (Cross, 2013; Sharma, 2007), particularly within the 'energy transition' (Jolly, et al., 2012).

Off-grid solar energy has a remarkable power to beguile those invested in it. Particularly when combined with the 'smart', data-led technology developments taking place across the world, but particularly in South Indian tech-hubs, the SolarFuture 'smart' micro-grid has a huge potential for engaging wide audiences. The 'hype' around the information and communication technologies for development (ITC4D) movement, as explored by William Mazzarella (2010), lays a groundwork for understanding this. Mazzarella describes the juxtaposition of "middle-class techno-fetishism" (Mazzarella, 2010, p. 784) with rural development mandates which adhered much of the ICT4D movements. This juxtaposition could be relevant in the Urjapur micro-grid, which acted as a similar confluence between Bangalore-led technology movements and more localised realities. Mazzarella also explores the ways in which the emphasis on specific 'solutions' served to obscure more ambiguous outcomes from access to internet in development contexts. This arguably resonates with the alternative processes of repurposing and *jogad* around the Urjapur micro-grid, which served to adapt and alter the system and to challenge its fundamental meanings, including those around 'smart' technology. This chapter breaks down the ideas around charisma into three facets: those surrounding the material technology itself; the people associated with it; and the potential futures the micro-grid offered and the ways in which these captured imaginations. Broken down this way, we see the different appeal of the micro-grid to different audiences and within this exploration of charisma, it is possible to explore the strong component of directionality of the charisma and its intersection with the asymmetries in the power relations embodied in the micro-grid.

This chapter explores how these three facets of 'charisma' attached to the micro-grid were constructed and perpetuated, but also deconstructs them with relation to the often 'darker' sides to this charisma, where the polished exterior of the project served to blur localised disillusionment with solar, more problematic power dynamics and alternative 'smart' ways of living which already existed in the community. It explores, through using the ideas of charisma, the ways in which both the technology and the people involved with it, seemed to inspire and mobilise people and continued to preserve and provide resilience to an assemblage that was seemingly being pulled in many directions and in many ways seemed unstable and precarious (Huang, 2020).

7.2 Charismatic Technologies

Anshuman and Santosh often referred to the Urjapur micro-grid as a 'pilot project' or 'proof of concept'. As Santosh once said to me, while discussing some of the challenges they were facing, "If we can make it work in a village like Urjapur, we can make it work anywhere". From wider conversations, it seemed they had not been anticipating such difficulty with the project and that the Urjapur micro-grid went from being a road test in a microcosm of an Indian village to what they saw as the most 'extreme' conditions. However, it also served a purpose as a showcase. The micro-grid had a lot of visitors and became something of a tourist attraction.

For visitors to the micro-grid, it seemed that, overwhelmingly, the buzz around the micro-grid fell very much on the technology, as opposed to its context, the people using it or the social governance structures around it. Visits to the micro-grid in Urjapur would always follow the same pattern (Gardner, et al., 2012). Visitors were driven into the village, chauffeured in bright white four-wheel-drive vehicles, and would stop outside the control room. They were usually dressed in business shirts and well-polished shoes (which were remarkably impractical, given the heat, dust and terrain) and clutched smart phones (sometimes complaining about the lack of phone coverage within the tiger reserve). They were predominantly men and would usually be brought by SolarFuture, with the obvious aim of leveraging contacts and future funding opportunities, but some arrived independently, having heard about the micro-grid through word of mouth.

Mukesh would be summoned to unlock the control room, which was situated at the entrance to the field where the solar panels were installed. The field was surrounded by paddy fields, with the crops in them often crushed in places by elephant footprints. Visitors had to walk

over a small concrete bridge over a ditch built around the fields. The visitors would be shown the battery banks, control panels and processing units and would cluster around asking questions and taking pictures on smart phones. It was notable that very few in the Urjapur community had ever had access to see inside the control room. The visitors would then be taken through the back to the solar panels themselves. There, they would inevitably pose for photos in front of the glistening panels, with the lush forested hills in the background.

After the photos, they would drive to the ecolodge, around one hundred metres down the road, where they would have lunch prepared by the cooks at the lodge. They rarely visited the village itself, short of stopping to look inside one of the locked smart meter boxes located next to each of the hamlets. Few spoke to anyone from the village apart from those at the lodge and Ravi, Jaya and Mukesh switched from their usual lively, outspoken selves to being quiet and subdued, serving food, speaking only when spoken to and providing careful, diplomatic answers to any questions they were asked. The community treated the visitors with a similar level of ambivalence, having grown used to the comings and goings to their village. Visitors rarely stayed the night in the ecolodge, instead staying in Angul or driving the four hours back to Bhubaneswar. They all gave the impression of being busy people, so the shortness of their visits was understandable in some ways, but it also emphasised the lengths people would go to visit the grid, when the village and area it was in apparently had so little interest to them.

It was clear that the physical micro-grid, particularly the field of solar panels, was the star of the show, but the visits seemed essentially performative. Micro-grid visitors rarely spoke to anyone that they could not have met in a conference room in Bhubaneswar or Bangalore. Any information on the technical characteristics of the system could just as easily be shown through a PowerPoint presentation. Particularly during summer, the visit would be far from comfortable, even with the air conditioned cars; it was hot, there was no phone reception and, while possible to travel in a day, it was a long and bumpy drive from Bhubaneswar. Yet there was something captivating in visiting the micro-grid *in situ*. Perhaps it was the novelty of leaving stuffy offices for the tranquillity of the forest, but in large part, the draw seemed to be seeing the solar micro-grid ‘in the flesh’. But since no visitors went inside the homes of anyone using the grid, they barely even saw the electricity from the system being used. Instead, they were seeing shiny equipment in a control room, with humming fans and flashing indicator lights.

The micro-grid was visually striking. The contrast between the dense forest, *kutcha* houses, elephants' footprints and dusty roads and the sleek, shiny silver panels was compelling; it provided a visual representation of hi-tech innovation installed in the most 'low tech' place, a proof of concept for the 'smart' rural future which Anshuman promised. The juxtaposition between 'smart' and what was implied to be non-'smart' played into its allure. There was clearly something captivating about the contrast. For an audience of visitors who mostly came from engineering and technology backgrounds and who had already invested in the narratives around the potential for solar energy, it seemed to reaffirm the conviction that this technical solutions could be the 'fix' even in the middle of a remote forest.

Through these visits, combined with presentations that Santosh and Anshuman did at conferences and events across India, the micro-grid garnered huge amounts of attention. The 'smart' component, in particular, gathered significant attention, from the BBC article mentioned in the introduction and features on the national state-run Doordarshan News channel to features in webinars, conference proceedings and publications in the sector. This rush of attention was notable particularly because micro-grids were by no means new to the South Asian context; the Meragada micro-grid mentioned in chapter 6 had been installed over 15 years prior to the SolarFuture micro-grid. The 'smart' component of the technology and the wider vision for the SolarFuture project had still managed to create buzz and renew excitement around it.

However, the charisma that had such a hold on the visitors to the grid contrasts with the disillusionment for solar energy in Urjapur. The ubiquity of solar PV, in various different forms, in villages across India meant that any novelty from it had long since worn off. It was striking that the urbanite, 'educated' visitors flocked to visit the micro-grid, while the community themselves built more nuanced understandings of its failings. Aside from the apparent disillusionment and discontent that was apparent around the micro-grid, and solar energy more widely, the technology was also never designed to be charismatic for those in the community. It was instead, curated for an outward facing audience. Indicative of this were the ways in which the interfaces of the micro-grid were presented to different audiences. Alongside the well-rehearsed visits to the village, there were slick PowerPoint

Figure 9: SolarFuture online interface.

presentations, with flowcharts, mind maps and diagrams. SolarFuture even ran a website which included a map of the village (see figure 9), with each individual load highlighted in real-time when someone in the community was using electricity. Visitors to the website could see live information of which houses were using electricity from the grid, how much load they were drawing and which streetlights and community loads were being utilised. It was a tangible representation of the 'smartness' in the system. The interface, though a different scale, was not unlike the central government website for its electrification mission, *Saubhagya*. This used a dashboard to make a live count of the villages being electrified across India as part of the mission, complete with heat maps showing the areas that remained unelectrified (Government of India, 2019). They both catered to audiences far outside those being electrified or provided with micro-grid energy, instead directing their message at potential voters or potential investors. They had a similar effect of externalising the process of electrification and the control over that electrification. But there also undertones of surveillance and 'big brother' style development. They provided a clear message to potential

funders or project implementors that this technology enabled an ability to oversee the behaviour of the communities they were working in.

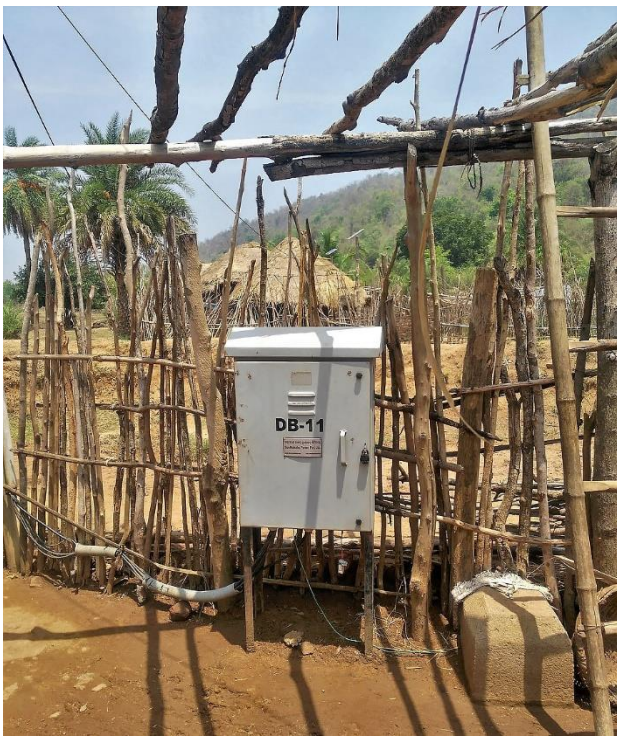

Figure 10: Urjapur locked control box.

By direct contrast, however, as Girish had mentioned, the same smart meters which collected the data that enabled this surveillance were quite literally kept under lock and key in Urjapur. Throughout Urjapur, large metal boxes were propped up against fence posts (see figure 10), usually outside of each *sahi*. Inside, was one smart meter per household, with a flickering screen detailing the energy usage, which were never seen by those using energy. Likewise, the batteries and control panel were padlocked inside the control room and in the village only Mukesh had a key. These were purportedly for safe-keeping and to prevent tampering, but they also removed any ability for the community to participate in the 'smart' components of the system that had garnered so much attention to the system. Elsewhere in India and in other parts of the world, 'smart' energy has been hailed as a means to engage and 'empower' users in understanding and interacting with their energy usage (McHenry, 2013). While 'smart' metering more widely has experienced criticism for its perceived lack of inclusivity (Sovacool, et al., 2017) and concerns with the surveillance and security (McKenna, et al., 2012), in Urjapur this was extended to a new extreme and was a deliberate part of its approach. The very technology which had mobilised such excitement by those designing and visiting it, was locked away from the village community. It still constantly collected data on them, but it was entirely one sided. In effect, the 'smart' technology was being used *on* the community, rather than by used *by* the community. It was perhaps no surprise then, that the charisma attached to the micro-grid, which garnered so much external attention, was entirely lost on those in the community; it was never intended for them in the first place.

7.3 Charismatic People

It was not the technology alone which mobilised the micro-grid assemblage. The people around it were critical not only in shaping and building technology, but also in curating the image of it and curating their own personas to succeed in the networks and spaces which facilitated the micro-grid. As indicated by Satyabrata, Anshuman was a central figure, who was credited with conceiving the vision upon which the micro-grid was built. Anshuman himself was charismatic. He was well spoken, approachable and full of infectious excitement about his project. One of the engineers working at the university campus described him as "a rural person", saying that this was why he understood villages. He had roots in rural Bihar, and while he was by no means a 'villager' in the same sense as the Urjapur community, his persona as a "rural person" lent him authenticity in speaking on rural issues. He was also highly educated, well-travelled and spoke multiple languages. As an IIT (Indian Institute of Technology) alumnus, he leveraged a level of respect and his remarkable social network (King, 1970; Subramanian, 2015), through which he accessed government officials, investors, CSR agents and others, seemed to stem at least in part from this alumni network. After his undergraduate degree, he had moved to the US to complete a PhD in engineering, where he stayed to work for many years. He fulfilled a middle-class Indian dream of an American education which brought status and gravitas to his project. On his return to India, he became involved in green technology, working on consultancy projects with the World Bank before founding SolarFuture. In being both well connected and 'worldly', but with roots in rural India, he had claims to authority in both directions, which provided authenticity for the vision he was proposing. He could speak the language of the global tech world, but with a familiarity with the rural, non-tech world. In some ways, his story seemed reminiscent of themes in the 2004 Bollywood movie *Swades*, in which Shah Rukh Khan portrays a non-resident Indian (NRI) NASA engineer, who returns to his native village and, shocked by its conditions, works to 'reform' the community (Swades, 2004). Of particular note is the part of the movie where Mohan, the protagonist, learns of the power cuts in the village and sets up a small scale micro-hydro plant to help the village develop. This is symbolic in its portrayal of electricity specifically as being the indicator of modernity, prosperity and development, and one where engineers specifically, are cast in the role of the 'saviours'.

But echoes of this storyline were not only present in Anshuman's past. The renewable energy sector in India has multiple figures like Anshuman, all with a similar story of having grown up with ambiguous 'rural roots', attended elite universities in India, before moving abroad and

returning to 'transform' rural India, through innovation and entrepreneurship. In South India, Magsaysay award ('Asia's Nobel Prize') winner Dr Harish Hande heads up the widely renowned SELCO India solar PV 'social enterprise', which made its name selling solar home light systems in rural Karnataka, gaining international acclaim (Knowledge@Wharton, 2010). R K Pachauri, the former (and controversial) head of the Energy and Resources Institute (TERI), giants in the Indian energy access sector, has a similar trajectory of studying and working in the USA, before returning to India and ultimately launching the 'Light a Billion Lives' campaign, one of the most ambitious off-grid energy projects attempted in India (Mohanty, et al., 2010). Complementing this, other large players in the off-grid energy enterprise space in India, such as Mera Gao Power, are headed up by American or European individuals, but they still have the hallmark of centring around the individual figurehead and in promoting specific values and power relations.

There are numerous overtones in the way these personas are built and how they frame the charisma around such entrepreneurs. There were politics around how people and knowledge had travelled and formed around the world (Meyer, et al., 2008), reinforcing a dominance of Global North education and experience within the space (Khandekar, 2013), but also combining a pride in Indian-born innovation. The idea that an individual could have 'made it' to a comfortable, affluent life in the US (a dream for many middle class Indian individuals and families (Radhakrishnan, 2008)), but 'given it up' in pursuit of social good evokes elements of both patriotism and martyrdom. These social entrepreneurs are fashioned, or fashion themselves, as guru-like figures, exposing wisdom and inspiration and being adorned with domestic and international awards for their innovations (Sen, 2007). This was expounded by the virtuous morality attached to working in the renewable energy sector, combining the benevolence of 'saving' the under-electrified with being the clean energy providing, environmental saviour. Added to that was the charisma of the technologies themselves, creating a version of 'technological saviourism' (Abdelnour, 2015). The life narratives of such 'social entrepreneurs' play key roles in mobilising their visions and invite audiences to empathise with their 'mission'. The SolarFuture BBC article, for instance, describes a visit Anshuman made to his home in Bihar and conversation with his niece, who tells him "just bring me light", as a key point in forming his resolve to work on rural electrification as an issue. The role of these life narratives serve to build the charisma of the individual and to provide background to their innovations, placing the technologies as central to their charisma.

A critical component to the charisma around Anshuman seemed to be his connections within influential networks that were central to mobilising SolarFuture. Indeed, it often seemed that a well-functioning micro-grid was secondary to the relationships which existed around its cultivated image (Ferguson, 1994; Mosse, 2005). For the most part, I had little insight into how this functioned. I followed the regular updates on the SolarFuture social media, where they were attendees at off-grid energy summits, award ceremonies and conferences and, from what Anshuman and the other engineers mentioned, they were working on numerous potential opportunities in villages in other parts of Odisha, in Jharkhand and in Uttar Pradesh, in collaboration with governments and large companies. Whenever Anshuman and Santosh passed through Odisha, they seemed to be a constant travelling trade show, running between meetings and engagements to leverage opportunities and build the SolarFuture brand. They alluded to meetings with state officials and funding bodies as well as collaborations with an international network of researchers and developers. Tracing the assemblage outwards in other directions could have provided an enlightening understanding of how the SolarFuture model was built on a wider scale.

While his external persona was somewhat curated to capitalise on the existing status and connections he had, this did not seem to be a cynical attempt at self-promotion. He had a genuine passion for and belief in his project, which stemmed from a desire to use technology to help rural communities in the most 'sustainable' way he saw possible. In conversations with me, he had a level of awareness about the shortcoming of his project, though this was arguably distorted by the understanding of the micro-grid translated through the 'smart' system. However, regardless of Anshuman's image outside the community, his charisma did little to translate his passion for the project to the Urjapur community. Despite the claims of him being a "rural person", this did not seem to reflect the relationship between him and the community. There was a clear gap between him and the community, stemming from a rural-urban divide, caste, class, language, wealth and educational differences, which created a somewhat ambiguous relationship between them. His more junior engineers had markedly closer and more informal relationships in the community, particularly with Mukesh, but for Anshuman there was more distance. The nature of the 'smart' system meant that he was not simply a dislocated benefactor to the community, instead interacting and making more frequent visits. While he was trying to negotiate with the community, they were not his 'customers' in the sense that he was trying to sell them things. His well-connected, social entrepreneur persona was largely lost on anyone in the community and it was unclear exactly

how they saw him. He was, by and large, respected, even while people critiqued the micro-grid or his operation. Their comfort in critiquing the grid, in the case of Jaya and Ravi even directly to Anshuman, in itself might indicate a more balanced relationship than, say, with the police or forest office with whom they had very different relationships. Anshuman and the other engineers clearly did not wield the same authoritative power as the police and forest officers in the community. This was indicative of how the villagers responded to the micro-grid, with efforts to push back on, negotiate and undermine the system. By contrast, everyone in the community was significantly more cautious about critiquing the rules around hunting and poaching (beyond the larger efforts to protest in the reserve). The efforts of the engineers to create and police 'good' and 'bad' micro-grid users through the 'smart' system largely went unacknowledged in the community.

However, within Urjapur, there were people who definitely had other types of charisma which appealed more to the local community and which had more power over how the micro-grid was perceived. Ravi and Jaya, for instance, clearly had influence over the community that derived from both their status in village hierarchy, but also how they interacted with different groups. They were seen as being part of the community, in a way that Anshuman was not, but they also had a degree of status. Jaya, in particular, had a charisma in the community that was arguably unconventional, but also made her able to communicate with people across the community. Women from all backgrounds seemed to look up to her and she clearly advocated for and supported them on a regular basis. Her challenging of gender stereotypes allowed her to take on more roles in the community, including engaging in discussion with men in positions of power and with Anshuman and SolarFuture. SolarFuture recognised her role in the community, with Anshuman telling me early on that she was influential, but that I might have difficulties getting her on 'my side'. He mentioned the importance of keeping her happy in order to gain tacit acceptance of the micro-grid elsewhere, though he seemed to begrudge this. In reality, she was one of my most important interlocuters and while her influence in the community in some ways derived from her higher caste, more educated and wealthier position, she also had a genuine investment in the wellbeing of the community. She was not being 'difficult' with SolarFuture for the sake of it, but because she did not see the micro-grid as serving the community in the way it should. Ravi had a different type of 'charisma' in the community. He and his family had considerable influence on the community, much of this stemming from their position in caste hierarchy and their control over resources in the community. But Ravi himself was also well

respected, and his views were trusted. His work in the ecolodge demonstrated his ability to mobilise members of the community to support the endeavour. Equally, his efforts to petition the block office, were acknowledged in the community as being indicative of his efforts to gain more resources and government provisions. It was also clear that what he said about the micro-grid had impact elsewhere; if he was reticent to pay, other households seemed to follow suit.

The contrasts between the types of charisma within the micro-grid assemblage and the audiences that they appealed to possibly resulted in the tensions between different visions. If Jaya or Ravi had been enraptured by Anshuman's vision the same way the engineers had been, it was not hard to envisage that a resulting relationship between the community and the micro-grid might have been very different. Equally, had SolarFuture done more to ensure that key people in Urjapur were invested in the system, it might have garnered more cooperation from the community. The persona of the 'social entrepreneur' leveraged little in the Urjapur community, but it also seemed that for the 'success' of the SolarFuture model (as opposed to the specific Urjapur micro-grid), it was more important to mobilise the excitement attached to it to people in positions of power, including the funders of the system. The charisma that mobilised and adhered the wider micro-grid assemblage was quite separate from that which mobilised the individual project. However, even if the charismatic individuals on a community level had been more invested, there was a fundamental mismatch in the visions proposed by the micro-grid and those envisaged by the community.

7.4 Charismatic Futures

Aside from the material technology of the micro-grid and the people who implemented it, much of the charisma attached to the smart micro-grid seemed to centre on the future vision that it promised. Particularly in the university campus, it was this vision that seemed to mobilise so much commitment to the project. That this vision was shared across the engineers working on it seemed to contribute to its resilience. From the outset, Anshuman sought to "use technology to solve social issues", but the project went beyond this. What he had proposed was not simply a supply of electricity, but a transformation of the entire community; it was not just a 'smart' grid but an entire 'smart' village. The university campus acted as a lab for testing innovations, but Urjapur was the true ground for experimentation.

The range of futures that the micro-grid was built around, and the off-shots that it had inspired, were explained in detailed by Maduli, a lecturer at the university who was

responsible for the development of hardware components of the micro-grid. He was enthusiastic about the system and had seemingly inexhaustible ideas about what it could mean.

> *We need energy consciousness, to change the village mindsets to technological ones. The toughest villages need the smartest systems for this, with an app, remote control, software and hardware and utilising resource evaluation communication. These are simple, empty-headed fellows.*

The way he described the system not only highlighted what he saw as the potential in the community, but also how this reflected his views on who and what the Urjapur community was.

> *We need to make people energy consumers. It is required to create energy demand or thirst even when there was no power, in order to drive a sustainable model. Then there are plans to back the system up with gasifier plants, so it will still work when there is rain and cloud. We need to enable a number of different sources of generation in our testing here. Then they can be deployed as applicable, not just in rural settings. Next, we will move the system into more remote monitoring systems, for things like precision farming. The weather, soil and growing qualities can be organised and monitored from here. We can give the farmers exact instructions on how to maximise all their crops.*

There was a clear disconnect between how the engineers saw the system and how the community did. As seen in chapter 4, there were regular complaints about inadequate electricity supply from the micro-grid because it was only provided for specific purposes at certain times of day. The idea that the community were the 'problem' because they were not demanding power contradicted my conversations with the community, where most had clear ideas about what they wanted energy for and how they wanted to use it.

I also wondered how the idea of remote control farming would go down in the community. While I assumed many might welcome more assistance, it was unclear how the marauding elephants, deer and boars would be controlled from the campus, or how 'smart' agriculture would intersect with existing farming methods, which were adapted to the local ecosystem. The characterisation of his version of farming approaches as 'smart', implying existing methods were characterised as non-'smart', was problematic. It downplayed the complexity of existing challenges and overlooked the endless adaptation and *jogad* that had already

been undertaken by the Urjapur community to maximise their agricultural production methods. His technocentric approach depoliticised the challenges in the community, making no mention of the politics of the forest office, a factor regularly discussed in the community.

> *Then there are the livelihoods. We will use them to create additional social upliftment. This is where it is especially important to have an academic institution involvement, as opposed to a company. Livelihoods, combined with education on the app and the use of smart technology around QR codes and apps, utilising Wi-Fi from the data centre will create a greater, more observable, constructive change. There will be a lifestyle transformation and options will be opened up day to day. But with livelihoods we need more market chain and ecosystem development. The community do not know how to use power, so they need educated, as there is a complete lifestyle shift required. The machines need to be as simple as the people, but there are projects being developed at IIT Karaghpur that could help. The aim is to get people to stay in villages, and for that there have to be livelihood sources in the village. Economic migration damages the village ecosystem, so institutions like SHGs have to be involved in these interventions, otherwise the village will self-paralyse.*

The "observable, constructive change" he referred to seemed to apply only to what could be witnessed by SolarFuture engineers from their control room. He dismissed the validity of any shifts that happened outside of their model of a 'smart' future. The idea that the community needed 'trained' in order to understand how to use electricity was almost laughable; it dismissed any capabilities or aspirations which existed in the community, or were conceived of by anyone outside the SolarFuture team. The ways in which he envisaged using the technology to stop people from migrating spoke to the wider aims of the project in controlling the community. What he was suggesting put the engineers in an authoritative position, resonating with Foucauldian theories of 'energopower' (Boyer, 2014) in how the micro-grid might enact power over the community. In reality, as was explored in chapter 4, this was much more contested by the community. I left conversations with Maduli feeling uncomfortable. The way he spoke about needing to educate and change mindsets in Urjapur was infantilising and unfairly portrayed the community as helpless and "simple". His views, and how he expressed them, were more explicitly dismissive of community agency and ability than any of the other engineers, but they resonated with many of the implicit assumptions of the technological design. His own students had significantly more respect for localised

structures and norms. However, while he was only one of many engineers, he did have influence over the system design and implementation. His desire to change how people thought, to initiate 'social upliftment' and to outsource control in the village spoke to much more than providing an electricity connection.

It was clear that the way Maduli viewed the community was vastly different to how they viewed themselves. The assumptions upon which the 'smart' system had been designed failed to capture the lived realities of the village. The 'smart' grid proposed a raft of new solutions to 'solve' rural issues, with little thought into what existing solutions might already exist or even a nuanced understanding of what the issues were. The 'smart' visions that Maduli, Anshuman and the other engineers invested in were largely not realised and it was hard to see how they ever would be. This was primarily because of the unexpected ways in which the community participated in the micro-grid to push back on the aspects of it which they did not want and the ongoing negotiations to remould the micro-grid to fit into the community's terms of usage. Ultimately, the community themselves were much more significant actors in the micro-grid than the engineers had anticipated or even acknowledged. While the community did not necessarily have insight into the full extent of data being collected on them or how engineers anticipated using it in future, they were still actively subverting the system to change the outcomes from it. This challenged the deep-rooted assumptions of what constituted in the 'smartness' in the system and the future visions that would be realised.

The proposed 'smart' agriculture was particularly indicative of this. It pushed for data-led control and regulation of agricultural parameters which failed to understand the complexity of challenges facing farmers in the community and their existing mechanisms of working around them; it was not 'smart' at all. The 'simple' machines that Maduli mentioned failed to acknowledge the complexity of how the community were already working around the challenges that existed in accessing secure forms of income. His blithe mention of migration did not acknowledge that for many young men in the community, the primary outcome of the entire micro-grid project itself was the opportunity to access skills that could enable them to migrate and earn a higher income. He made a casual mention of the self-help groups (SHGs), but did nothing to acknowledge how these intersected with much wider gender structures in the community, or gendered expectations of the micro-grid itself.

7.5 Conclusion

This chapter suggests applying theories of charisma (Weber, 1947) and charismatic technologies (Ames, 2014) in order to understand the micro-grid project and its appeal the Urjapur community. The technologies, people and futures associated with the SolarFuture micro-grid combined to create a charismatic vision of the project which captivated the engineers working on it, as well as external audiences. This was a carefully curated image for the potential that the micro-grid held, proposing a specific future imaginary of hi-tech, data-led development. The 'smartness' of the system, while indicative of the specific technologies used, implicated much wider shifts in how the community functions. On a wider scale, the global energy transition lends itself well to future imaginaries (Cloke, et al., 2017). Policy makers, researchers and engineers have all been tasked with reimagining how societies will function after fossil fuels and many have acknowledged the potentially necessity for a fundamental shift in how society is organised. The 'transition' presents itself as an opportunity to reimagine which has been grasped upon by those working within these spaces. The rise of smart city and smart village movements imply attempts to revise entire community structures, lifestyles and relationships in order to achieve a 'sustainable' future. In this way it is unsurprising that the appeal of the 'smart' micro-grid was not simply in providing energy, but visioning an entirely different future for the village.

However, as is acknowledged within the theoretical framings of charisma (Friedland, 1964), the charisma surrounding the micro-grid was far from universal. The same charisma that seemed to mobilise both the Urjapur micro-grid and the wider SolarFuture project was at odds with the localised reality it was installed in. There was an entirely different view of the project from the engineers than there was in the community; indeed, the charisma that was derived from perceived project 'success' simply did not exist on the ground. The charisma that the visitors to the micro-grid seemed to see in the technology, was met with wide scale disillusionment from the village. The charisma that enabled Anshuman to participate in tech-centric development spaces was ineffective in the community compared to the localised charisma of people like Jaya and Ravi. The futures imagined by the engineers of the project were not the same futures imagined within the community, nor did it seem possible that they could coexist. They operated on contrasting scales, within time spans and relating to an entirely different set of actors.

These contrasts open up opportunities to re-evaluate what constitutes the 'smartness' of the system. This resonates with other calls to expand understandings of 'smart' beyond purely technical understandings (Kumar, 2019a), but also to challenge who decides what 'smart' is or should be. The 'smartness' of the SolarFuture system did not engage with local futures or local forms of charisma. It was unable to see the power structures and the political economy of development in the village, indeed, the charisma arguably served to obscure these. The micro-grid system had little capacity to understand the full complexity of the challenges in the community, which were comprehended and enunciated eloquently by the community themselves. Chapter 3 explored the strategies already employed across the community to work around these complexities, which I termed as *jogad*, but conversations with the engineers made it clear that these existing strategies and practices were effectively 'scripted'-out of the 'smart' system. In the drive to reimagine and transform the community, there was a fundamental disconnect between who and what the community were and wanted to be, and what the micro-grid offered and tried to enforce.

8. Engendered Micro-Grids

8.1 Introduction

Once I had left my field site in Odisha after the end of my fieldwork period, I took a three month placement in Delhi through a UK based energy research network. I was to work with a consortium of research organisations, think tanks and NGOs who were being funded to development a network of organisations working across India and South Asia at the intersection between gender and energy. This period ultimately acted as an extension of my fieldwork. Whilst in Delhi, with visits to Chennai and Bangalore to run public workshops around the gender and energy, I found myself observing some of the central discussions on how organisations and businesses working in energy were engaging with questions around gender inclusion, empowerment and equality.

I had expected the role to be challenging; the organisations involved were high-profile and well respected nationally and internationally, but had reputations elsewhere in the sector for being hierarchical and rife with organisational politics, something I was warned about by friends and former colleagues before taking up the position. However, I also thought the project would be restorative; a touchstone of sorts after spending a year surrounded by the complex gender dynamics of my fieldwork context and with increasing frustration around the gender politics of the ground-level energy space. I had hoped to find common ground with practitioners, researchers and policy makers who valued a gendered perspective on energy projects. On an individual level, I did find this. I met individuals doing valuable work at the intersection of gender, energy and development and with whom I had insightful conversations which helped me make sense of my field data. But in many ways, these instances were dwarfed by the overall realisation that many of the very same structures my research participants found frustrating in Urjapur, and which faced the women in the hostel at the university campus, were alive and thriving within the prestigious institutions operating in the Delhi energy space. In turn, these organisations were supported and endorsed by international funders and networks. The experience crystallised commonalities across all three sites and prompted me to conceptualise these social power structures as not just isolated around the micro-grid context, but in how they were perpetuated throughout the off-grid energy sector on a wider scale.

There are no prizes for recognising the structural issues around gender that are pervasive both in India and globally. In this sense, it was not surprising that wider patriarchal structures would be present at every turn. However, given the sites that are explored within this chapter had intersections with each other through the wider assemblage of the micro-grid and within the energy and development space, it was apparent that these gender structures were not just inherent in the context, but also were serving to reinforce and re-enact patriarchal structures throughout the assemblage. To understand this, it is important to conceptualise the connections between the spaces explored in this chapter, and the means by which gendered structures translated between these. The intersection of gendered structures between these places is not only pertinent in terms of the geographical places and spheres of influence of each, but also in terms of the role they played in the micro-grid assemblage and in how knowledge and understandings of energy and energy practices translated between them. Both the institutions in Delhi and the engineers in the university campus drew their understandings of energy from data and information flowing from Urjapur and villages like it, which was then used to inform technical design and policy and project development. In Urjapur, the influence of those designs and developments was materialised and experienced by inhabitants of the village. The flows of knowledge, data and influence that moved between these sites were filtered through numerous people, relationships and social structures, to create specific and mutually reinforcing understandings of gender across the space that will be explored in this chapter.

In Delhi, the organisations I worked with were central to shaping government policy in the on- and off-grid energy sectors. Their messaging on topics like gender inclusion had influence on private and non-governmental actors in the sector, including Anshuman and SolarFuture, and they had influence on the agendas that dominated the energy sector; from the collaborations that were made around energy projects to the global funding streams available within the sector and in the training of young professionals in the energy space. By and large, their understanding of energy and energy policy was derived from the quantitative and qualitative research the organisations undertook in villages across India, many of which had a specific focus on gender and energy. The university campus in Berhampur was where the ideas for the micro-grid came to fruition and where it was designed and tested. It was where many of their engineers were recruited and where the control room for the system was situated. It was where decisions were made about how the system would operate, about what energy usages would be prioritised and where the fundamental ‘scripting’ of the

technology took place (Akrich, 1992). In Urjapur, the micro-grid was materialised and, as seen through this thesis, was constantly being reshaped and reformed through the push and pull processes over control and use of the system. It was the key site for the critique of the system and where its energy was being generated and consumed. It was the flow of data and information from Urjapur which enabled actors in the wider system to draw their own conclusions and understandings of what the micro-grid was doing, how it was impacting people and what could be taken from it to inform future projects. Most immediately obvious was the data on energy generation and consumption that was transferred through the smart system and monitored continuously. SolarFuture engineers were also drawing from conversations with community members (particularly community leaders) on how they designed and implemented their systems and the choices they made. This was informing the practices and processes which took place around the research on the campus. For the organisations and institutions in Delhi, villages like Urjapur were where data on the usages and impacts of energy projects was gathered, which was then used to build evidence for specific policy and project recommendations and to shape understandings of rural energy usage. Indeed, Urjapur itself was also where I drew most of my own analysis and conclusions for this thesis.

This chapter centres its analysis within the social construction of technologies literature, particularly those relating to feminist understandings of gender and technology (Faulkner, 2001; Bray, 2007; Wajcman, 2010). It draws influences from both existing literature looking at the intersection of gender and energy (Cecelski, 2004; Oparaocha & Dutta , 2011; Farhar, et al., 2014; Winther, et al., 2020), as well as the rich body of South Asian feminist development literature (Batiwala, 2007; Sharma, 2008), which has sought to understand and deconstruct the gendered structures of society and of development processes more widely (White, 1997; Cornwall, et al., 2007; Kabeer, 2015). Social constructivist feminist technology studies (FTS) theory conceptualises technology as "both a source and consequence of gender relations", where technologies are constructed within a specific set of socio-technical relations (Wajcman, 2010, p. 149). As explored throughout this thesis, these relate not only to physical objects, but also to institutions, symbols, language and identities (McNeil, 2007). This chapter explores gender relations as they relate across all levels and phases of technological development, being shaped by and shaping gender relations through the processes of policy making and project conceptualisation, design and implementation and usage and consumption (Wajcman, 2010). In particular, the use of Connell's concept of

"hegemonic masculinities", described as "the configuration of gender practice which embodies the currently accepted answer to the problem of the legitimacy of patriarchy" (Connell, 1995, p. 77) within FTS serves as "a tool to explore how particular gendered identities are attributed, achieved, performed and their place within broader configurations of power" (Bray, 2007, p. 41). This is critical in understanding not only the impacts of types of energy access on gender relations (though these are important), but also in understanding the implications of patriarchal structures within the spaces and networks which construct the technologies constituting micro-grids, paying particular attention to the power relations which are embedded within these (Lohan, 2000). This resonates with Bruno Latour's ideas of "technology as society made durable" (Latour, 1991, p. 103), where gender relations are "made durable" within the design and use of a micro-grid, as well as the design and implementation of policy. Within the context of all three sites however, there is also a need to explore the extent to which gender relations influence the formation of understandings of the technology and how this then subsequently shapes policy, research and design.

This chapter predominantly focuses on the gendered components of these spaces and in the threads that ran through and connected them. This is not to say that gender is the only social structure which could be examined in this light or which had threads through the many sites of the micro-grid inception and implementation. Indeed, structures around caste, religion and class presumably have an impact on who was involved in the technology at various stages and how it was formulated. Indeed, these structures intersect significantly with gender. However, while the components of caste, tribe and religion were visible and widely discussed in Urjapur, they were acknowledged much less in the university campus (at least in conversation with me) and less still in discussions in Delhi, with the exception of ST (scheduled tribe), SC (scheduled caste) and BPL (below poverty line) policy provisions. Equally, these structures, while pervasive, are less immediately visibly apparent, particularly to me, as someone who has not grown up within a caste system. However, in contexts across India, analysis of class, caste, tribe, religion and linguistic group could all be grounds for investigation. They are touched on at points in this chapter as they intersect with gender, but merit more substantial analysis.

I acknowledge my own positionality within this; I am a woman who, like other women, has experienced and navigated varying levels of sexual violence, gender-based discrimination and gender politics throughout my life, including during the fieldwork period. Coming from

the Global North, much of the feminist discourses I have been surrounded by have been informed by white feminist critiques of society (Wolf, 2018; Mohanty, 2003). While, on a personal and intellectual level, I have done my best to diversify this and to engage with intersectional and decolonising approaches to feminism (Crenshaw, 1990; Mohanty, 2003; Lugones, 2010) I am aware that my normative expectations of what 'gender equality' or 'women's empowerment' might mean are not inherently universal, nor are they necessarily helpful in this analysis. While I empathise to a large extent with all my participants on this topic and recognise these structures from very personal experience, this chapter focuses on what the women in these spaces were saying themselves. It explores how they critiqued their experiences in these sites and how they made sense of the gender structures they lived, worked and studied within. It is, however, my interpretation of this data across the three sites that pulls it under one analytical gaze, and I have inevitable subjectivities within this.

The interlocuters in this chapter are mostly young, unmarried women without children, whose close relationships with me were in large part because of our proximate ages and me also being an unmarried woman without children, which, while we often had different life experiences and goals, facilitated a relationship with us being in similar social groupings. In Delhi, Berhampur and Urjapur, the quotes in this chapter were part of much wider conversations that went far beyond the discussion of energy or even gender structures. Even from my own side, they were more akin to the conversations I have with friends than with research participants (Kirsch, 2005) and, indeed, I would count many of these women as friends. The conversations we had were very much forward looking; it was people planning their future careers or to having and providing for their families. For all of them, society was changing and they had different goals and aspirations to their parents, though this caused tension in many situations. This has an interesting alignment with the 'future' focus of the micro-grid project and many of the discourses around energy transitions. Both discourses spoke to change and progress, but who envisaged this and what they envisaged were vastly different. However, for all that the women in all three sites were envisaging changes, these rarely figured in the future views of the micro-grid or of the energy sector more widely, and arguably challenged some of the assumptions within development around the 'capacity to aspire' (Appadurai, 2004). While the micro-grid envisaged a future that changed how the community operated, specifically including enterprise start-ups, 'smart' technology and various versions of e-governance, e-medicine and e-education, it was striking that it did not aim to challenge any gender structures. Indeed, it enabled existing gender structures to be

maintained and perpetuated. Likewise, in Delhi and Berhampur, there was discussion of 'change' and 'transition' in terms of energy policy and technology and even change in terms of the gendered usages of energy. However, the gender structures of these places themselves seemed remarkably stagnant and unchanging. As women's rights movements across India challenge wider societal gender structures, there was a reluctance and lethargy to enact change within the energy-sector spaces, be that the institutions in Delhi, the university in Berhampur or the micro-grid in Urjapur. This put gender particularly at odds with the narratives around change and futures often associated with discourses on energy.

8.2 Delhi

During the time I spent in Delhi, the project I worked on had an explicit gender and energy focus. This focus did not look solely at micro-grids, but across the wider spectrum of energy related policies, projects and interventions. It largely revolved around a series of workshops on the topic, which took place in Delhi, Bangalore and Chennai, with the aim of galvanising support for work at the gender-energy nexus across India and aiming to provide knowledge sharing and advocacy platforms. It was funded by a UK-based academic network working on energy and the organisations involved all had extensive experience working in the gender and energy space. This included undertaking qualitative and quantitative research in villages across India (including some villages which I happened to visit while in Odisha), the conclusions from which fed into the development of policy recommendations and into ground level projects. While detailed, situated research in places such as Urjapur highlights many of their singularities and individuality, there is also an extent to which villages, like Urjapur, were viewed as the 'generic' Indian village (Thakur, 2007). The activities of those in Delhi both drew information and understanding from and subsequently pushed ideas and influence onto this generic village, often without nuance or specificity. This raises questions about what was filtered out of localised understandings to produce the blueprints and models for conceptualising energy transitions and, critically, who was doing the filtering and with what subjectivities. These questions are also pertinent to the narratives around the 'scaling' of technological interventions that are common within the renewable energy sector (Bridge, et al., 2013; Cloke, et al., 2017). They necessitate sets of simplified assumptions about communities through which 'scripts' for design or policy can be created.

In the processes of planning and running the workshops, I spent periods of time with the junior members of staff, who were mostly women, working in the participating institutions.

We spoke often about gender, in the context of the projects we had worked on and workshops we were organising, but which more often arose in the context of organisational dynamics and the hierarchical, patriarchal norms which dictated them. There was no shortage of anecdotes from young women frustrated about their experiences in these organisations and the ironies of working 'on gender' while embodying oppressive norms around gender were often highlighted. In private conversations these were elucidated freely, but there were clear limits on what could be said more publicly, for fear of backlash from the organisations themselves. Before I left, however, I asked several of women to put down their thoughts in writing, with the assurances of anonymity and confidentiality.

> *I came to [this organisation] fresh out of college and was truly naïve when I first witnessed the toxic work culture here. I thought the misogyny, casual racism and unethical quality of work was hidden from the highest authorities, but it turned out to be deep rooted in the organisation's core values.*

This was a statement made by one young woman, Arpita, who worked at one of the organisations involved in the project, that summed up many of the sentiments I heard while in Delhi. She described how, at first, she had assumed that she was witnessing and experiencing isolated incidents of gender based discrimination and harassment, racism and ethical problematics, before realising that these issues were endemic to the organisation and condoned by even the directors. This realisation shifted her perception of the organisation itself, from problematic individuals, to the entire organisation fostering a 'toxic' culture. This organisation worked extensively in the development research and policy sector and were well connected to influential actors within the Delhi policy making elite. Her account raised fundamental questions about the ethics of their operation.

In one organisation, a senior researcher on their gender and energy research programme was of particular concern. A young woman who worked alongside him, outlined her concerns. "He has no sense of personal space and his body language and physical proximity to female co-workers is enough to make you feel uncomfortable, these gestures are made towards female interns and co-workers only. He undermines their work and reduces them to objects whose relevance to a project is solely dependent on their looks, and their ability to agree with him unconditionally." She said the same man had been accused of harassment by an employee at a partner organisation, "There was no action taken against him, but the woman was removed from the project… Many times, now, they chose male consultants and

freelancers because it is easier to avoid conflicts with them which will definitely arise with female consultants." The young women sharing office space with him would rotate their lunch breaks, to make sure no one was left in a room alone with him.

The man she spoke about was heavily involved in the wider projects the organisation ran with respect to gender and energy. He was regularly selected by the organisation to present at conferences, including the workshops we were running. At the time, I relayed the issues that both myself, and the women in these organisations were having with him to the Europe-based funders of the project. They gave a sympathetic response, placating my concerns and saying they would note the issue. I later found out the same funders were funding him to attend and present at multiple international conferences, speaking on the same topics of gender and energy. The hypocrisy seemed remarkable. It demonstrated a complicity across global networks claiming to have commitments to gender equality in reinforcing power relations which were routinely being exploited. It almost seemed like an endorsement of his behaviour, in providing space for these same structures to be perpetuated. This would not be considered appropriate in any field, but specifically begs the question of how gender structures can be approached within the study of energy if the abuses of power relating to it are systematically ignored.

While these comments were made in private, similar allegations have also played out in the public sphere, in relation to one of the most prestigious institutes working in the energy space in India. In 2016 the *Caravan*, a Delhi-based journalism magazine, published an exposé on the then director general of The Energy and Resources Institute (TERI), the late RK Pachauri (Saxena, 2016). The article investigated allegations of sexual harassment made against Pachauri, who had been chairman of the Nobel Peace Prize winning Intergovernmental Panel on Climate Change (IPCC), as well as suggesting that TERI had fostered a culture of "tacit acceptance" of his conduct. TERI were, and still are, considered giants in the off-grid energy sector, with projects and programmes spanning across South Asia and the Global South more widely. Pachauri had been eminent within this, well known for spearheading projects including the 'Light a Billion Lives' initiative (TERI, 2020), one of the most ambitious global clean energy projects. The allegations resulted in criminal investigations and a scandal that sent shockwaves through the Indian energy sector. The ongoing investigation was watched closely by those in and outside the sector, with Pachauri himself going as far as to publicly blame the allegations on climate change sceptics intent on

undermining his reputation (The Guardian, 2016). Pachauri ultimately stepped down as director of TERI and largely stepped back from the public eye. The incident shed light on the structures and practices that were endemic within the institution and, potentially, within the wider sector.[26]

However, it would appear that little adjustment had taken place in the sector in wake of the Pachauri scandal. Women at numerous organisations talked about their experiences with their male, senior colleagues; "They comment on other employee's physique, their age and marital status," one woman said. At a different organisation, another said, "I know two colleagues who have been subjected to subtle comments (about their clothes, weight) and one of them supposedly faced hostile behaviour for not encouraging this attitude of that staff. I also know of an acquaintance who had to give [organisation name] an ultimatum to change her division because a senior was troubling her and passing unwanted (and stupid) comments about her."

The concerns of young women in the organisations were not limited to unwanted comments or harassment. Alongside this, many were keenly aware of their precarity in the organisations and the extent to which they depended on the benevolence of their male superiors. "I've heard that [employee name] used to promote his favourites (including young women) to good positions", said one woman, frustrated by her lack of progression within her organisations. Another said, "If you disagree with them or speak up against them, they will simply fire you or make your life worse. The pay scale is very skewed here… it's all in the hands of the directors… they can choose whom to pay more to and nobody questions that." Pay gaps, access to promotions and recognition were key issues, with one woman saying, "There is a massive pay gap, female employees do not get promoted, even when their contributions are at par. They are not sent for inter-state or international conference because 'it may not be safe'."

It was notable that these opportunities denied to younger women on paternalistic concerns around 'safety' were then ultimately dominated by older men (including the man discussed earlier), who then spoke on topics surrounding gender inclusion and equality. This was reinforced with the division of work on large projects. Often, those undertaking the bulk of

[26] And also within the wider humanitarian and development sectors, as evidenced by numerous different experiences of sexual violence, both directed towards beneficiaries of aid interventions and aid and development workers themselves, highlighted in the #MeToo/#AidToo movement in 2018 (Costello, 2018; Gillespie, et al., 2019).

ground level data collection were junior women colleagues, who were sent to the field to undertake interviews and surveys. Behind the scenes, they also wrote and drafted articles, press releases and publications on this data. When opportunities for publishing came around, however, if they were included as authors at all, it would be as the last authors on the list, with their more senior colleagues taking greater credit. Despite being critical in the construction of this knowledge, they were all but written out, reinforcing existing structural inequalities within publishing and policy making (West, et al., 2013; Sovacool, et al., 2015).

This is important not only in how the work is credited, but also begs further questions about transparency and about how these knowledges were produced and how this shaped the understandings of energy being proliferated within these spaces. From more informal conversations with women who had undertaken fieldwork, it seemed that we had lots in common in our experiences. Like me, they had often established close relationships with women in the communities and would comment on the complexities and nuances of village life. However, the published results rarely portrayed much of this, instead aligning with the established narratives of the organisation, in propping up policy claims or supporting certain project outcomes. Some of this was a by-product of the different methodological approaches; few utilised ethnographic methods, and surveys and structured interviews were more commonly used. However, the tacit contextual knowledge held by young women researchers, particularly in how they spoke to women in the field, was often absent from the final product. By extension, the experiences of their interlocuters in the field were effectively written out and the knowledge produced was filtered by the gendered hierarchies of the organisations producing them.

The breadth of complaints, ranging from harassment, to gender pay gaps, hostile environments and exclusion from opportunities, promotions and recognition illustrated the extent to which young women specifically were marginalised within these organisations. The discussions with these women spoke to a concerning reproduction of damaging hierarchies within the gender and energy space. It seemed remarkable that a movement marketing itself on advocating for gender reforms in energy policy and energy could be so hypocritical and wilfully ignorant when it came to their own organisational practices. This was not lost on the women who worked in these organisations. The complacency and complicity of international funders, who appeared to do little to engage with the internal dynamics of these organisations, equally seemed to perpetuate the issues. It seemed almost as though the

working ‘on gender’ in whatever abstract form that took, was taken as an opportunity to absolve the responsibility these organisations, and their funders and collaborators had for ensuring safe and equal work environments for their staff. To speak of the ‘empowerment’ of women through energy access is almost laughable, when women in their own organisations remained systematically marginalised.

In my opinion, these events, discussions and allegations warrant both academic and institutional scrutiny in and of themselves. They demonstrate the impacts of structures which systematically marginalise, harass and abuse young women, which are endemic in the off-grid energy space and are reinforced on multiple levels. They are structures which should be paid attention to on national, local and global levels, with mutual accountability through partners and donors.

Beyond this, however, these structures also had implications on the type of research that was produced, on the conclusions that were being drawn and on the voices that were heard speaking about the topic. For me, this was laid bare within the workshops themselves. The research undertaken by these organisations took centre stage at the workshops for the project, and they became critical sites for understanding both the conversations that were being had around gender and energy on a national level, but also to observe the structures that were played out more implicitly in the events and in the sector more widely.

8.2.1 Workshops

Representatives from a range of NGOs, enterprises, research institutions, universities, government offices and policy think tanks were in attendance at these workshops. They were predominantly from India, with some speakers from other South Asian countries and attendees from the European project funders. Some attendees presented research on gender and energy, others talked from experience working with enterprises at the intersection and others advocated for and reviewed policies that intersected with these themes.

By and large, gender in energy access was framed in one of two ways, with women either framed as entrepreneurs, responsible for their family’s developmental prosperity through increased energy access, or as ‘victims’ of household drudgery, where energy plays a role as

emancipation from domestic and reproductive labour (Standal, et al., 2018).[27] These were often talked about as justification for why gender and energy was an important topic. There was rarely much nuance between these and while literature on wider understandings of gender and energy have gained traction, the discussions rarely spoke about the inclusion of women in decision making processes (Winther, et al., 2020) or as part of power relationships (Winther, et al., 2016). In and of itself, it was striking that there was a need to justify the focus of gender in energy discussions. In centring discussions on these two framings, there was an implication that these were the only two energy 'domains' which had gendered intersections and implications for women and were, effectively, 'feminised'. By extension, it implied that any energy usage outside these, and the technologies associated with these, were either not gendered at all or did not concern women. If the role of women in using energy only becomes relevant when framed around women as agents of development as entrepreneurs or as domestic labour, particularly while cooking, it implies wider energy generation, consumption and governance is therefore masculinised by default. This speaks to the hegemonic masculinities highlighted within feminist technology studies approaches (Bray, 2007), and which were replicated with respect to the micro-grid (see below). They framed energy usage by or for women as compartmentalised deviations from its 'normal' uses, inherently excluding women from ownership, decision-making and usage of energy.

Much of the discussion at workshops revolved around the uses of energy for cooking. While not a focus of my own work in Urjapur, the way it was discussed highlighted how understandings of energy seemed to be shaped in these spaces. Cooking was justified as a specific focus of the gender and energy space because it was 'the woman's domain' (a phrase directly quoted from numerous presenters). Energy interventions centred on the role of reducing drudgery in the lives of rural women, sometimes followed with the caveat that then 'the woman' would be able to spend more time looking after her children or running enterprises. 'The woman' was frequently referred to in the singular form, as if representative of a singular identity and experience across rural Indian women. In the same way that the generic village was used as a blueprint for understanding energy and energy transitions, the creation of an archetypal 'woman' for such discussions also necessitated a level of simplification and implied homogeneity, but enabled the 'scaling up' of conclusions drawn

[27] Both these framings can also be helpfully deconstructed within the wider literature of both gender and development, where they arguably relate to women in development contexts often being framed somewhat simplistically as 'heroines' and/or 'victims' (Cornwall, et al., 2007).

from research and put into policy. The process of how this was defined was also gendered and produced through the ostensibly male-dominated discussions taking place at the workshops. It enabled a level of filtering of nuances of intersectional gendered experiences of energy interventions and potentially an opportunity to discard inconvenient alternative understandings of how energy policy and projects impacted women and gender relations.

If a government representative or high level policy maker were in attendance, there would often be a seemingly tactical alignment of the discussions in support of whichever policies they had implemented, indicating a pandering to political favour and influence over critical debate on gender. An example of this was the *Pradhan Mantri Ujjwala Yojana* scheme*,* usually referred to as *Ujjwala*. It was a central government programme launched by PM Modi to provide LPG connections for up to 50 million women in BPL households (Urpelainen & Gould, 2018). The scheme was registered in the name and bank account of women, with the aim of reducing 'unclean' cooking fuels, such as biomass and kerosene, to reduce both the drudgery involved in cooking and the health implications from use of 'unclean' fuels. It was discussed endlessly in the workshops, with numerous organisations presenting research into its efficacy, the logistics involved in it and the challenges in implementing it, much of which has also received considerable academic attention. The deep irony of one such panel, entitled "Women's experiences of LPG subsides" which was entirely male dominated was not lost on the women in the audience, though went unacknowledged by the panellists themselves. These studies, rather than presenting women's opinions, perspectives or accounts of using LPG subsidies, were primarily based on quantitative survey and government supplied data on LPG cylinder refill patterns, time use patterns and expenditures. They focused heavily on the technical and operational components of the policy, such as distribution centres and uptake rates.

In another workshop, the government official responsible for the scheme attended himself, and a full session was dedicated to hearing his perspective on the scheme and asking questions. He was a high ranking official and clearly leveraged significant influence. He himself pointed some of the flaws in the operation of the scheme, for instance the difficulty in facilitating replacements for LPG canisters once the first one had run out. However, in response to his speech, he was met entirely with praise, with many in the room applauding his benevolence in catering to women. The fact it was targeting women seemed to trigger the assumption that it was inherently beneficial to women, without critical examination of

what the wider implications might mean. The scheme was treated as being exceptional within the energy space, despite appearing fairly unremarkable. The response seemed to consist more of appeasing him, a useful contact and respected guest, than advocating for effective and influential policy.

At another workshop in Chennai, however, this was challenged. This workshop had a session dedicated to a group of women farmers from Kerala and Tamil Nadu, who could not have been further socially from the policy maker. They spoke in Malayalam and Tamil which was translated by one of the researchers at the institute. The inclusion of rural women representing themselves in such a venue was striking, particularly in its departure from the norms which usually dictated those spaces, which largely gave a platform to well established, predominantly male speakers from elite institutions. When asked about the *Ujjwala* scheme and the shifts to LPG, one woman bluntly replied, "We shouldn't have got too used to LPG. It's useful because it reduces the time that we spend cooking, but it's costly and the schemes for getting replacements don't work. It shouldn't be spoken of as women's empowerment, it's not like my husband does any of the cooking, it's still all me." She deconstructed the assumptions that had been made around the scheme and its relationship to women's empowerment, challenging the idea that an energy policy targeted at women was inherently 'good' for women. This pushback took many in attendance by surprise, but also added a critical and more contested understanding of what energy was to women and how the assumptions around it had been constructed. For me, her response was much more reminiscent of what I heard in Urjapur than what I was hearing in Delhi; it was grounded in her everyday reality and pulled apart the development logics that had propelled the scheme in other discussions, particularly those dominated by elite men.

The intersections between what was said in the discussions in the workshops and in the relationships and structures of the organisations played out in the workshops themselves. There was a clear separation between gender and energy as it was discussed in workshops and public events and in how it was acknowledged (or not) within the workshops and organisational structures themselves.

One of the young women, Divya, involved in organising the workshops, particularly in planning and inviting speakers, had her own anecdotes on the procedures behind how they were selected.

Most of the professionals doing exemplary work in this field are young women. When the list of participants and speaker was being decided, many women were recommended, but the organisation blatantly refused to give these women a platform to showcase and disseminate their work, because 'they were too young'. Instead, a group of senior officials from the government was invited, and all of them were men. This was truly upsetting for a young female professional like me, because it discourages my work… decades ago, women didn't have the same opportunities to study and work as they do now. That means that all the women who are doing excellent work in their respective field right now are below the age of 45-50 years old. Organisations like [organisation name], who have the opportunity to give these women a platform, to discuss their research and findings with government officials and other people at discussion making positions, should not discourage relevant female participation, just to get 'older experienced men'.

Divya's frustration spoke to what she saw as an exclusion of particularly young women from having a voice in the discussions around gender and energy. She saw the conversations being dominated by older men, on the justification that more senior and well respected speakers would carry more gravitas. She saw this as undermining many of the goals of what the gender and energy workshops were aiming to do and as discouraging for someone who was just starting out in a career in the sector. She recognised the progress that had been made so women could do research, work and participate in the sector, but questioned its worth when they rarely got a platform to share this.

When she highlighted the dynamics within the workshops themselves, she was equally frustrated. She referred to a specific instance of two men, who presented statistical research about the impacts of the *Ujjwala* government scheme, and their interactions during audience questions.

They didn't entertain questions by female audience members, and the one time they did, they tried to gaslight her by convincing her logic was flawed. When the same concern was raised by male audience members, they admitted that there may have been something wrong with their analysis. The female participant, who quickly left after the incident, was clearly insulted by their behaviour.

Divya's use of language such as 'gaslighting' spoke to what she saw as more problematic than rudeness or overzealousness in the workshop setting, but to something that indicated a level

of abusiveness in the relationships and structures which governed these events. The dynamics she spoke of were visible within workshops to an observer as well. Even while the topics of gender inclusion and representation were discussed in discourses, there were clear patterns as to who in the room got to speak, for how long and from which organisations. These encompassed both gender structures, but also clear patterns of hierarchy. The platforms given to younger women were in the minority, but it was clear that there were a small number of older women who had managed to leverage a level of respect and authority in the space. These older women were often the heads of their respective organisations and part of the Delhi policy elite. They were able to participate in male dominated spaces with a level of seniority, possibly by adopting elements of male personas, but did little to support younger women or to open the doors to increased gender parity. It was conspicuous that younger women were decidedly at the bottom of the hierarchy, despite potentially having the most recent ground-level research experience. It also reflected a distinct hypocrisy in who was included and whose voices were listened to. This pattern was mirrored across the university campus and in Urjapur itself.

8.3 Berhampur

The observations and conversations I had in Delhi were both fascinating and troubling. However, what struck me most was the way in which this resonated with many of the dynamics that I had witnessed in the university campus in Berhampur at the beginning of my fieldwork period. This was where the technical design, testing and control for the micro-grid took place. While Delhi played an arguably more abstract role in shaping the knowledges of gender and energy, and contributed to policy decisions and wider understandings of energy, Berhampur had a direct and constant connection to the Urjapur micro-grid. There was a similar relationship, however, in how they were removed sites where understandings of energy, in village contexts particularly, were formed and subsequently shaped into design, policy and project decisions. There were, unfortunately, distinct parallels in the experiences and concerns of the young women who lived, studied and worked in them.

As discussed in the previous chapter, the university campus where the research took place for much of the micro-grid system and where the control room for the system was located, was very much orientated around the ‘smart’ innovations that were happening. At least on a superficial level, the university did well to present itself as a hub for learning and innovation. It was a private university, located in Berhampur, a town located on the south eastern

coastline of Odisha, around 200 km south of Bhubaneswar. Berhampur had a reputation elsewhere in the state for a high level of violent crime. The students told me that the campus had been opened there because its founders, who still ran the university, owned the land it was built on and decided to use it for the institution, or as one student put it, a business opportunity. Most of the student population came from outside of Odisha (jokingly said to be because Odia people were unlikely to choose to send their children to Berhampur), with large numbers coming from Jamshedpur, along with other parts of Jharkhand and Andhra Pradesh. The university was reasonably well regarded for being a private institution (which in India are often less prestigious than state run higher education institutions (Gupta & Gupta, 2012)), but for most of the students it had not necessarily been their first choice.

The highway running outside the campus was thought to be particularly dangerous, and accordingly, the campus was self-contained, with high walls and security guards who carefully checked anyone entering the campus. It felt like a strange environment for a university. I stayed in the girls' student hostel[28] while on the campus, a decision made by the SolarFuture-affiliated staff member who was hosting me so that I would not be alone in the guest facilities on the campus. Unintentionally, I gained a first-hand view of college life for the women students. From the outset, it was clear that alongside the curated 'smart' innovation hub, the development of the micro-grid was taking place in a complex and often troubled context.

There was a strict 6 pm curfew, at which point the gates of the girls' hostel would be drawn. Male students had free range of the campus until much later. Anyone who missed the curfew risked their parents being contacted. One evening while I was there, a first year student did not return in time for the curfew. In the few hours it took to locate her (she had gone to visit a family member without informing the appropriate college authorities) there was a palpable fear that something had happened to her. No one spoke explicitly of what this fear was, but it was clear that everyone's mind had gone to the same place and other students were clearly distressed. The restrictions placed on women seemed both to ensure a level of moral propriety that was expected of them, coupled with specific dress codes, and as an almost paternalistic form of protection. No one acknowledged why the risk on the campus after dark was perceived to be so much higher for women than men, or even why male students

[28] I refer to the hostel as the girls' hostel because this is how it was termed by everyone in the campus. The young women who lived there were all adults, but the terminology arguably reflected the paternalism and infantilisation that were common within the institution.

themselves could be seen as part of the risk, but it made for an atmosphere that was constantly tense. The inherent misogyny in these rules did not go unnoticed by the women students, who regularly complained about the limitations on their movements. Everyone was aware of the risks to women across India, but they pointed out the asymmetries in how the curfews and dress codes were applied, with many saying they were looking forward to moving to larger cities after graduation, which would offer more freedom.

I stayed in Berhampur in the lead up to summer, when it was hot and very humid. There were frequent power cuts and, while the lights were backed up with generators (and with the smart solar system that was being trialled), the fans in the hostel rooms went off, often making them unbearable. The students in the women's hostel would go up to the large roof, where there was a breeze, until late at night, when the wardens would send everyone to bed. They would make phone calls to family members and boyfriends, chat and gossip with friends and watch and share videos. It was there that I had numerous conversations with students from different years about life in the campus. It felt like a freer place than anywhere else on campus, away from hostel wardens and college staff. The students were keen to tell me about things that had happened there, without me asking, and the picture that they painted was of the campus was one of conflict, tensions and control.

One of the biggest topics of conversation was the conflict that had erupted between two of the boy's cohorts the previous year, said to be over who sat where in their dining hall (the boy's and girl's hostels had separate eating facilities within them, which were, it seemed, governed by strict social rules). The situation had escalated to the point that the police had had to enter the campus, apparently after one student brought a gun. Alongside this, they told me about student suicides in the university, said to be because of stress, bullying and relationship problems. The details I got were hazy, and had potentially been exaggerated to some extent. On a day to day basis, not everyone was entirely unhappy in the campus, but it painted a picture that was far from the polished image that came with the SolarFuture PR material. The idea that the micro-grid would be engineered within such a space seemed bizarre.

A common discussion topic was what the students would do after they graduate from the university. Many who I spoke to were involved in the renewable energy 'club' that supported the SolarFuture project and all were taught by the staff members involved in it. Many of the men were keen to continue working in off-grid renewables and pursue careers in

organisations like SolarFuture. SolarFuture had already hired several graduates from the college, but despite many women graduates having the skill sets that would enhance SolarFuture's team, only men had been hired. According to Anshuman, this was not a choice made by SolarFuture, but a reflection of their difficulty in finding women to hire. I had been sceptical of this at first, unsure of whether they had made many attempts to hire women specifically. But from conversations with women in the college, it seemed that the ways in which they were making their post-graduation decisions was entirely different to many of the men. I spent a lot of time with two fourth year electronics engineering students, Vaishali and Swati, both of whom were involved in the SolarFuture project and with whom I had multiple conversations about their futures.

"There was one girl in our year whose family pulled her out in second year to get married. She lives in Berhampur now. She was only 19, she cried every night before it happened." Vaishali said.

"Thankfully our parents haven't done that yet, but I know they're thinking about it." Swati added.

"You don't want to get married?", I asked.

"God, no", they both laughed.

"I want to move to Bangalore. I need to get a job so I can move and have freedom there. It's more relaxed there." Swati said. "I'm desperate to get out of here. Everything is so controlled."

"I'm going to try to go to Kolkata," Vaishali said.

"You wouldn't want to work with SolarFuture like Navin?" I was referring to a recent graduate of the college who joined SolarFuture.

"Neither of us could, our families are controlling. We have to go to a big city or stay at home, there's no in-between. They would never want us to take a job which had so much travel to villages." Swati said.

Both women were academic high achievers and had good chances of securing graduate jobs in any large technology companies. They would also have been valuable additions to SolarFuture's efforts. However, they were leveraging the opportunities their education had

given them to pursue a level of autonomy and 'freedom' that they felt they would not get if they stayed near their families.

Conversations such as these illustrated ways which, in effect, young women were excluded from the design and control processes associated with the micro-grid. It was not necessarily a direct result of the micro-grid sector itself, so much as the intersection of social pressures and expectations on, and aspirations of the women who might have filled those roles. Given my own difficulty in finding a female research assistant for my own project, this was unsurprising. There were parallels with the Delhi conversations as well. While in Delhi young women were effectively excluded through problematic organisational structures and practices, here it was a combination of familial pressures and a desire to escape the controlling confines of the university campus.

Vaishali, Swati and I talked about life inside the campus. Having been there for three years already, both were more than ready to move on to things outside. Like other women, they were frustrated by the lack of independence and constantly being overlooked by the college authorities, particularly the hostel wardens. They also saw issues with how the college was run and the power dynamics which lay with specific members of staff.

"He makes the female students feel uncomfortable." Vaishali referred to one of the male lecturers in the campus, who was involved with the SolarFuture project. "He messages students on WhatsApp while they're in the hostel, it's inappropriate."

"There are so many rumours about what he's said to students and things that have happened. We try to avoid him. You should avoid being in a room alone with him." Swati added.

I asked why they could not report him.

"He has control over our grades, no one can raise concerns here. People in college management would support him, it would hit us harder."

These concerns were echoed in other conversations, with other students asking if I would be able to raise a complaint on their behalf, since I would be leaving the campus anyway. This question presented an ethical dilemma, as I was aware that raising an issue this early on in fieldwork would most probably have compromised my relationship with SolarFuture that I needed to access my data. I also had no idea how this would be received and what backlash

there might be, for me or for the students. It highlighted the strange positionality of being a white woman working in this context, where I was both simultaneously navigating my vulnerabilities as a woman, while being keenly aware of the power afforded to me as a white outsider with the ability to leave.

There were clear endemic issues across the campus around abuses of power. The environment within which the women students lived and studied was heavily controlled, with distinct gendered power dynamics (Rogers, 2008). These issues are far from unique to this individual college campus, with much of the Indian #MeToo movement in 2018 centring around abuses of power in college campuses across the country (Dey, 2018; Gupta, 2018).

These structures within the campus raise a question about how the micro-grid, formed and controlled in such a space, could ever be separated from these dynamics. For instance, the decision making on who to include in the processes of engaging the community in designing the system and in allotting the scheduling for the system were all made within this environment, and arguably served to exclude women in the community (see below). It begs an understanding of how the technology produced in this space embodied some of these dynamics, but also how they served to intersected and reassert the gender dynamics already existing in Urjapur itself.

8.4 Urjapur

Working in the off-grid solar energy sector prior to my PhD, I was already aware that the perspectives and experiences of women were routinely underrepresented and underacknowledged in the design and implementation of solar PV projects. This, in part, led me to undertake this PhD in the first place. Based on similar concerns elsewhere, in more recent years the role of gender within energy supply chains and clean energy uptake (Jairaj, et al., 2017) and the gendered implications of energy access have been explored in much more detail (Oparaocha & Dutta, 2011; Clancy, et al., 2012; Standal & Winther, 2016; Winther, et al., 2017; Osunmuyiwa & Ahlborg, 2019).

The demographics of the village meant that on a day to day basis, particularly outside intensive farming seasons, there were more women and children living in the village. Men more often migrated outside for work, to factories or *dhabas* in Cuttack and Bhubaneswar or further afield to run shops, drive autos or work as security guards in Chennai, Kolkata or Mumbai. Some also worked for the forest office and were rarely at home. Apart from

meaning that we spent much more time with women in the village, it also meant that the users of the micro-grid were predominantly women, though this was rarely acknowledged by SolarFuture.

In conversations with women, the issues facing them were a common theme and difficult to ignore. On the surface of it, issues around domestic violence (particularly associated with alcoholism) (Krishnan, 2005), patriarchal family structures (primarily for caste Hindu families) (Malhotra, et al., 1995) and exclusion from local politics (Chibber, 2002; Jayal, 2006; Gochhayat, 2013) were similar issues faced in villages across India and were initially seemingly unrelated to the micro-grid project itself. However, these issues coalesced to create the ecosystem within which the micro-grid was installed.

Village governance was dominated by higher caste men. Both women, from any caste or tribe, and Adivasi men were largely unrepresented in village politics.[29] There were some subcommittees which allowed women on them, such as the water and agricultural committees, but, apparently, they never contributed and sat in silence. The overall village committee was entirely made up of higher caste men. This dominance was challenged at one point during fieldwork, when an attempt was made by Adivasi groups within the community to elect an Adivasi man to be village president. Within a day he had been usurped by his higher caste predecessor. There were concerns amongst the higher caste groups in the community that he would be incompetent in his role, as he was illiterate, signed his name with the thumbprint and "did not know how things worked", according to Ravi. The idea of a woman being in this role seemed unthinkable, they were not even invited to attend village meetings, including those run by SolarFuture.

However, women, particularly from higher castes, often spoke about wanting to be more involved in village politics. In a conversation with a group of young women in Gopal Sahi, they said "We would like to go to community meetings, but we would still have to go in a group of 10 or more. Otherwise we would feel intimidated, but we would like to be more involved in these things." The Gram Panchayat, based in Angul, had seats reserved for women, Scheduled Cast (SC) and Scheduled Tribe (ST) community members. However, it was widely

[29] Though this chapter largely focuses on gender, it is critical to disaggregate any implied equivalence between women and Adivasis in the community, not least because of the intersectional identities of Adivasi women (Kapilashrami, et al., 2015). Higher caste men dominated village politics and were most represented in discussions around the micro-grid, but there was nuance in the ways in which other groups were excluded.

acknowledged that the seats reserved for women would go to the wives of influential men. One woman in Gopal Sahi had been the Panchayat representative for the years from 2011 to 2016.

> *Serving as a ward member was frustrating. It was all men and they didn't let me be involved or give any role. There was tension between Simulia and Urjapur, so that made it harder. I earned Rs 4000, but it's easier to make money working in the fields. The meetings took me away from other work I had to do and my children. I ran for election in January, but I came eighth. People voted for me, but I was the only woman running so I didn't win.*

Participating in village and Panchayat politics, even when possible, seemed to be an uphill battle for most women, particularly as they balanced childcaring roles, farming work and other responsibilities. For Adivasi women, it seemed to be largely unthinkable.

Despite these challenges, in recent years Urjapur had experienced an upheaval in gender relations on a more domestic level. Apparently, alcoholism in the village was rife and many women blamed this, at least in part, for the high levels of domestic violence they experienced. The alcohol of choice, *khajuri tadi*, was brewed in the village from the dates of the *mahula* tree that grew there. As recounted to me by Jaya and confirmed, with pride, by other women in the community, eventually a group of women in the community had had enough. They decided to stop the drinking, in the hope this would stop the violence that went along with it. In the middle of the night, they cut down the trees and destroyed the equipment used to make the alcohol. They implemented a ban and fined any man[30] who came to the village drunk. Jaya said it had reduced alcoholism and related violence in the village considerably. Women from other villages had come to Urjapur to ask for advice on how they could do the same in their own communities. Alongside this, there were other longer term shifts around the lives of women in the community. Child marriage had all but disappeared in the village in the last ten to fifteen years, with mothers of teenage girls adamant that their children would not marry as young as they had. The number of children that women had was also reducing, though more so in higher caste families than in Adivasi

[30] I was told with some certainty that no women in the village drank or smoked. In other parts of Odisha and eastern India, the consuming alcohol by both Adivasi men and women, particularly as part of social gatherings and festivals, is common (Shah, 2011; Begrich, 2013), and has become part of perceptions of morality and the 'civilising mission' of Adivasis by both colonial powers (Hardiman, 1985) and caste Hindu communities (Froerer, 2007).

families. Wamika, the ASHA worker proudly told us a woman had not died in childbirth there for ten years. Though schooling was still difficult given the absence of teachers, there were a number of girls who travelled to Simulia every day to go to school, intent on having careers in teaching, healthcare and, where there were applicable reservations, getting government jobs. Young women spoke about their aspirations to move out of the community and to have love marriages, though these were often frowned upon by their parents.

These more uplifting shifts should not be viewed in isolation, however, and the gender relations in the community remained complex. At many points Subhra and I found Urjapur to be an emotionally challenging place to be. We would often listen to heart breaking stories of abuse, abandonment and loss. Though we never asked about sensitive topics, many women seemed to take us being there as an opportunity to talk through about painful issues. There never seemed to be an expectation that we would be able to help, but we were both painfully aware of our inability to do anything other than listen (Rager, 2005). At the time though, it was striking that across the community, shifts around gender structures were taking place. Women were becoming proactive about their role in their families and the community and the efforts of Jaya, Wamika and the NGOs that had worked in the village previously, along potentially with government schemes, did seem to be slowly affecting change. Much like in Berhampur, the existing gender politics in Urjapur were complex, dynamic and evolving. The micro-grid had equally complex interactions with these politics and well as the intersections with the gendered politics of the other sites already explored in this chapter.

When SolarFuture started working in the village, they initiated a number of community meetings. At these meetings they assessed the viability of the system, gained consent from the community and invited each household to estimate the loads that they would wish to run on the system. This information was then used to design the solar PV, battery capacity and system configurations. Women were not invited and did not play role in the formal design processes of the micro-grid and ultimately, had very little relationship with SolarFuture. When asked, most women said they would have liked to attend, but that they never attended community meetings.

I asked one of SolarFuture engineers, who had spent significant periods of time in the community, why women were not invited to the initial community meetings. Given that it was women who spent most time in the village and at home, presumably they would be best

placed to estimate their household's future energy needs. As most of the people living in the community full time were women, they were also the key users of the grid. His immediate response was, "Why would we ask the women? All they use the electricity for is to watch [TV serials]".

Women did, indeed, use the micro-grid to watch TV serials. The introduction of the micro-grid had been critical in enabling the use of TVs and radios (Winther, 2008; Standal & Winther, 2016). Only a few houses had them and they became meeting points for groups of women. These groups largely consisted of neighbourhood groups, without explicit caste divisions. As well as enjoying the entertainment (at least during the hours in which domestic loads were serviced by the micro-grid as dictated by its controllers), many women spoke of the ability to watch soaps, movies and news programmes as making them feel more connected. Being in the forest, beyond the reach of phone networks, they often felt disconnected. Since many women only left the forest a few times a year, it made sense that access to broadcasts from Bhubaneswar and Delhi would dramatically shift this perception. One mother of a teenage daughter went as far as to say that this connectivity had inspired her to want to get more involved in community politics. Though she herself could not read, she now got her daughter to read newspapers to her so she could be more engaged and informed on current issues. Much like the village's wider response to the micro-grid, women had appropriated it to facilitate opportunities that they valued.

However, the reduction of women's use of energy to something that was implied to be superficial or frivolous was indicative of a hierarchy in what energy uses were validated, and therefore serviced, by the engineers. The way the scheduling around the system was planned prioritised so-called 'industrial' and 'economically productive' uses of energy during day (pumps, machinery, etc.) and 'domestic' loads to households only in the evening (such as TVs, fans and lighting). At the time of my fieldwork, many of the industrial loads had not been realised, though they included plans for pumping, small scale manufacturing units and livestock units and had been proposed in the meetings with the men in the community. These were seen as how the micro-grid would 'transform' the village. Within the village, the roles attached to these 'industrial' loads were not explicitly gendered. There were still gendered roles, but women, by and large, participated in farming, daily wage labouring and other income generating activities. However, the decisions to reserve 'domestic' loads for the evening predominantly impacted women. As one young mother said, during one of the

hottest summer days, “I would buy a fan to keep my baby cool, but there’s no point because it won’t run during the day.” The micro-grid had a potential key role to play in ‘reproductive’ and caring roles labour (Standal & Winther, 2016), and these were not met because of decisions made by the engineers, who had based their designs on meetings where women had been excluded.

Once again, this highlights the hegemonic masculinities built into the micro-grid technologies; from both the engineers of the system and from the community themselves. The decisions to separate loads along these lines was justified as matters of efficiency in solar capacity and battery usage. However, within them they built into the system the gendered expectations of the engineers and they were built on the back of gendered power differentials already existing in the village. Centring the use of the micro-grid around the notions of ‘economic’ and ‘enterprise’ uses as means for ‘development’ inherently relegated uses of the micro-grid outside of this definition, by women or anyone else, as being unimportant. These design decisions, whether made out of lack of communication, wilful ignorance or more explicitly malicious intent, ultimately became ‘gender script’ in the technology (Bray, 2007). The issues around this were frequently mentioned in the village, with complaints about it not providing 24-hour power being very common. This also brought in comparisons to the main grid, which, while unpredictable, did not, as a technology, dictate how and when people could use it.

However, these decisions were not only about what energy could be used, but who was involved in the process of making them (Standal, 2018). The absence of women from political processes in the community (under which remit village meetings seemed to fall) indicated a fundamental absence from participation in the design of the technology (Wajcman, 2010). The obvious exceptions to SolarFuture’s engagements with women, was Jaya. She was also the one woman who SolarFuture did interact with directly. Their relationship was often rocky; the SolarFuture engineers seemed to see her as bossy, difficult and interfering and, in turn, she did not hold back in her issues with the micro-grid project. However, they did seem to respect each other. What was significant about this, was that she was the one woman in the village who did not conform to gendered norms. She presented herself much more androgynously; dressing in men’s clothes, driving a motorcycle and running businesses. The way in which they interacted with the one woman who adopted more masculine traits

seemed in some ways indicative of their systematic exclusion of women and the inherent gendering of the micro-grid system as a whole, regardless of who was using it.

Anshuman and Santosh were aware that they had done a poor job of engaging with women in the community, from any caste or tribal group. They compared Urjapur to another village they were working in, in Jharkhand, where they said the women were less reserved and more willing to engage with the male engineers. They asked me how they could engage with the women in Urjapur and how they could involve them in enterprise projects. By that point they had recognised that for the project to be sustained long term and to be 'embedded' within the community (Ulsrud, et al., 2011), they would need to have women involved in it and, critically, engaging with their priorities for 'productive' energy usage. To me, it seemed there were a multitude of reasons why women were not engaging with this. For one, they had never been asked or consulted.

Beyond this, many women were well aware of the challenges that came with starting an enterprise, which was far from straightforward in their context. They lacked access to finance, training and markets and many were well aware of the risks they would be taking by investing in any such business. "When the NGOs were here to work with the SHGs we all invested in a poultry farm, but that didn't work. Then we start fish farming, but it flooded and we lost our investment. We're still paying that back, so we can't set up any other business," one woman said, who had tried multiple such enterprises before. Equally, on a fundamental level, it was not necessarily that women were uninterested or disengaged in the 'productive' uses of the grid, it was just that they had other priorities for the energy, even if these were not valued by the engineers. As discussed in chapter 4, some mentioned buying home appliances to attract brides for their sons, or even to ask for electrical appliances as part of dowry negotiations. These were far from what the engineers envisaged for the micro-grid, and yet became part of the discussions around it.

The only response I could give to Anshuman and Santosh was that they possibly needed to employ women in their team and invest greater time and energy in building relationships and understanding what women wanted to use energy for and how to meet this demand. At that point, SolarFuture was entirely male dominated[31] and all the people that SolarFuture had chosen to train to fix the micro-grid had been young men, from a variety of different

[31] At the time, after my fieldwork had ended, they later managed to hire a young woman from South India to work on their team, potentially because of these very reasons.

backgrounds and this was not without controversy. They were doing very little proactively to engage with women. This could have been down to not wishing to 'rock the boat' in terms of uprooting existing village dynamics, but their decisions to hire men from Adivasi and lower caste households had already caused a level of upheaval. When I asked him about his decision to hire men from across the community, he said, "We just want the best people for the job, we're not trying to disrupt the community. We want to build this as a meritocracy, I don't care what caste they are." Given that any decisions made by SolarFuture were inherently political, it was conspicuous that he had never made an attempt to hire women, who would have been equally capable of the basic maintenance of the system. Anshuman was willing to interfere with caste tensions, but left gender relations largely untouched.

The training of men to take care of the village had not gone well for SolarFuture; Mukesh told me that of the seven that they originally trained, all but him left the village with their new skills, to work in electronics shops in Kolkata and Mumbai. Mukesh said there were plans to train women instead. At first, they decided to train young, unmarried women, but realised many of these would migrate from the village upon marriage. They then realised that married women, particularly with children, also had numerous other concerns and responsibilities. Alongside this, I heard from Anshuman that they were having difficulty hiring a woman for their engineering team, who was able and allowed to travel in rural areas, much like I had found it difficult to find a woman as a research assistant (though with persistence, I had managed this). It should be mentioned explicitly that many of the stereotypes and concerns around women's inclusion in science, technology, engineering and maths (STEM) which are commonly part of understandings of gender and STS in the Global North (Faulkner, 2001; Ryan, 2014) need additional nuance in understanding their participation in South Asia. Since Independence, the participation of women in engineering in South Asia has swelled (with estimates in the range of 0.2% in 1950 to somewhere around 23% in 2005, with increases since then (Gupta, 2014)), particularly within electronics, electrical and computer science disciplines, to the point where some of the undergraduates course are female dominated (Parikh & Sukhatme, 2004). This trend is notably an urban upper- and middle-class phenomenon (Radhakrishnan, 2008); however, it indicates additional complexity in understanding the South Asia specific dynamics around gender and technology. The increased participation of women in engineering is not an indication of radical revolution in gender relations, so much as being part of the transitions in shifting labour markets, within which women's engagement in engineering roles can serve patriarchal familial and marriage

structures and social expectations of women (Gupta, 2014). However, this highlights the fact that there was no shortage of women with the technical skills SolarFuture needed (or the ability to learn these skills), but other ways meant that they were still ultimately absent from the design and operational processes (for instance, as mentioned by Swati, because parents and family would be unwilling to let their daughters work in rural contexts).

8.5 Conclusion

It was unclear the extent to which the relationships, interactions and conversations I observed were simply reflective of the wider patterns of patriarchy existing globally, in the South Asian context and within technology and development spaces. The patriarchal structures within the energy space could not be easily demarcated from those which already existed in the areas and societies within which they were situated. However, the linkages between these spaces indicated a level to which the energy space served to replay, reassert and potentially amplify patriarchal effects in specific ways. The assemblage around the micro-grid, which included the village, the university campus and, with a level of abstraction, the policy and research spaces in Delhi, provided an arena for the intersection of the numerous different ways in which gendered hierarchies and patriarchal norms were reasserted.

A critical example of this interconnection was the gender 'scripting' of the micro-grid technology in Berhampur, which could not be separated from its situation within a context rife with problematic gender structures, and the technologies which were then implemented in the Urjapur. The village governance processes excluded women, and the engineers made no attempt challenge this dynamic or to find alternative ways to engage with women, and thus, their impressions of the village, upon which they designed the system, was formed from a gendered version of the village. It was a cyclic process which served to reassert the assumptions and dominance of certain groups and to exclude others. These assumptions were then "made durable" (Latour, 1991) within the technologies themselves.

In some ways, this was mirrored in the processes of research and policy and project design which took place in Delhi. Though they did not interact with one single village in the same way, there were parallel processes of gaining understanding and formulating responses in ways which excluded and silenced young women in particular. This created something of an echo chamber, where assumptions and patriarchal norms were unchallenged. Arguably, within this, the processes of the rendering generic forms of 'the woman' and 'the village'

facilitated a scaling of not only policies and programmes, but also of the gendered scripts within them. They contributed to shaping the wider energy sector ecosystem that was formulated within these norms.

While my experiences and conversations in Delhi, Berhampur and Urjapur demonstrated a frustrating continuity in how patriarchal structures played out throughout the system, it was also marked that there was an emphasis in many conversations around change. Without exception, the women to whom I spoke described how their lives being different to their mothers'. They spoke about making decisions which pushed the boundaries of what they could do, be that moving to Bangalore to pursue tech jobs with more freedoms, attempting to climb the ladder at policy thinktanks or to pursue further education and change the expectations they put on their own children. They all came from very different backgrounds, classes, castes and contexts and so faced different barriers and conceptualised change in different ways. However, they all saw themselves as being part of wider societal movements around women's rights, opportunities and levels of empowerment. While energy access, research or study was not necessarily a critical part of this, it was striking than in an energy sector which so often spoke about transition, change and transformation there was such diversity the futures that were conceptualised. The 'transformation' of Urjapur that Anshuman saw very much maintained, or even amplified, the existing gender relations. Likewise, the futures envisaged by the lecturers and researchers at the university campus did nothing to challenge the gender structures which existed in their own institutions. In Delhi, even explicit discussions on gender and energy never extended to addressing the toxic work cultures in the institutions themselves.

Despite a burgeoning interest in the gendered components of energy access, it was striking that there were markedly few attempts to reform, or even acknowledge, the structures within the spaces themselves. At all levels, there were numerous potential opportunities for the energy space to actively pursue reparative practices around gender relations. For instance, in Delhi, the voices of young women researchers could be promoted through positive discrimination in access to platforms at workshops, conferences and paper authorship. Though not without challenges, this might serve to add nuance to the 'scripts' which inform the archetypal 'women' and 'villages' which policies and projects were designed around. This might even change the nature and types of research and policies produced. In Berhampur, while familial expectations might not be as easy to change, making

the campus safer for women may enable them to participate more in the designs of the micro-grid, and potentially even enabled SolarFuture to recruit from the women at the university. In Urjapur, SolarFuture could have survey women about what they want to use the micro-grid for and make decisions about when and how they provide electricity based on these understandings. There are clearly complexities and permutations within all of the potential measures and no individual 'solution' to the issues presented. However, it seems that there are, at the very least opportunities to begin to address the structures playing out across the system, and to support the women already pushing for change.

9. Conclusion

This thesis has presented an exploration into the politics, structures and negotiations around micro-grids in Odisha, India. It has centred around the story of a 'smart' solar micro-grid, installed in Urjapur, a village situated inside a tiger reserve in central Odisha. It utilised methodological approaches, detailed in chapter 2, which prioritised establishing a grounded, in-depth and situated understanding of the experiences, politics and relationships surrounding the micro-grid system. This thesis framed the micro-grid as an assemblage of ideologies, relationships, values and technologies, and aimed to deconstruct the range of meanings derived from it and to understand the processes of disassembly and reassembly by the people around it to remould the system. Central to this was a commitment to understanding the Urjapur micro-grid within the nuance and diversity in experiences and perspectives of those in the community. It also drew on data collected at other sites associated with the project, and with micro-grid and off-grid energy projects in the state, to understand how the Urjapur case study sits within the wider ecosystem.

This conclusion provides a summary of the thesis, utilising some of the core themes which run throughout the chapters: the contrasts, dissonances and contradictions embodied in the micro-grid assemblage; the role of *jogad* and appropriation in how people interacted with the micro-grid; and the precarity and instability which came to define the Urjapur micro-grid, as well as the wider landscape of micro-grids across the state. It then presents an epilogue to the thesis, narrating some of the developments which took place in Urjapur after I left the field and reflecting briefly on what these may mean for the wider understandings of micro-grids and rural energy access.

A central theme throughout this thesis has been the contrasts, dissonances and contradictions which were both embodied within SolarFuture's Urjapur micro-grid project and which existed in the wide array of different understandings of how people took meanings from the system. For me, the opening vignette in the introductory chapter characterised this. It retold the story of a fire which destroyed one of the control boxes housing the smart meters for a group of households in the village. Thankfully, it was put out before it spread to any nearby buildings or injured anyone, but it left the households without access to electricity for several days. Anshuman responded with concern and frustration about the high cost of

replacing the meters. He was aware that because of the ongoing reluctance in the community to pay for electricity from the micro-grid, he would have to go back to the donors who had funded the initial capital costs to fund replacements. He mentioned at the time that, in future, events like the fire (for which the cause was unknown and not discernibly through any fault of the community) might not be able to be fixed with donor money and, without community payments, the system would be unsustainable. This event highlighted some of the key contentions within the micro-grid and what it meant for the community.

The fire emphasised the precarity in the 'smartness' of the micro-grid, and not just in terms of the technical components. Whatever had caused the fire should have been a small fault with adequate fail-safe mechanisms to protect the people and structures around it. However, this fault not only a posed a significant practical risk to the community, but also had significant knock-on implications for the operating model of the entire project. In some ways, the swiftness with which the fire caused such damage demonstrated the futility of the expense, time and effort put into the meticulous technical design of the system. Without a nuanced and grounded engagement and understanding of the social fabric of the community, it seemed that the system would inevitably face challenges that would uproot it. It did not matter how 'smart' the system was, if it bypassed localised norms, practices and understandings.

The vignette also highlighted how the community responded to the micro-grid. Understandably, the initial response had been to protect the homes around it. While the control box was broken, the households around it did not have access to electricity in their homes; this resonated with some of the feeling of disappointment and disillusionment in the micro-grid, and in off-grid energy more generally. The feeling that the system had failed to live up to its expectations and did not fulfil what people felt they needed in terms of electricity access was common across the village. However, within a few days, Mukesh managed to rewire the micro-grid connection to bypass the control box. The households had electricity again, and this time without regulation and scheduling, meaning they could use it whenever they wanted. Mukesh's skills at reconfiguring the system demonstrated a level of adaptability within the community to facilitate temporary fixes where needed. The then unmetered and unregulated supply of electricity was quickly adopted to enable usages that would otherwise have not been possible. This resonated with the tendency across the community to engage in opportunities from development interventions when they arose,

and to appropriate and remould these to suit localised needs. Notably, the first uses that were prioritised were women watching TV shows and listening to music; potential uses of the micro-grid that had been mocked outright by the SolarFuture engineers (see chapters 3 and 7).

At first glance, many of the contrasts in the system presented a compelling narrative; hi-tech, data-led 'smart' technology installed in a remote village characterised by its forest geography and as being 'low-tech'. The incongruity was striking and, at least to some audiences, held a type of charisma. These contrasts signalled an almost redemptive shift away from the patronising narratives of 'appropriate' technology (Schumacher, 1973) towards an expansion of futuristic and transformative smart-cities approaches to rural contexts. As was explored in chapter 7, there were components of the micro-grid which captured the imaginations of engineers, funders and audiences to the micro-grid, mobilising key narratives around sustainability, rural development, energy access and 'smart' technology revolutions. While these served both to adhere and to mobilise the micro-grid assemblage, they were also at odds with localised realities.

The original 'script' (Akrich, 1992) with which the micro-grid was designed provoked many of the dissonances which arose when the micro-grid was installed in Urjapur. Chapter 4 explored many of these contentions. It interrogated some of the contradictory meanings taken from the micro-grid with reference to how people conceptualised their own lives and how they envisaged their futures, in contrast to the 'smart' transformation envisaged by the project designer. This ranged from the higher caste men who viewed and rejected the micro-grid on account of it being indicative of their state neglect and perceived it as vastly inferior to grid connectivity, to groups of women who fitted their aspirations for the micro-grid within their own lives; for instance, within negotiations for arranged marriage or through the future prospects their children might have. While many of these dissonances stemmed from discursive deconstruction of the micro-grid, in practice members of the community pulled more tangible, though unexpected opportunities, from the micro-grid. This was particularly reflected by the young men who used their training from SolarFuture to maintain the micro-grid to migrate from the village and use these skills in urban centres across India. The tensions around how people perceived the micro-grid contributed to an ongoing negotiation around it, which also became a process of deconstructing and undermining the system and its operating model.

The concepts around *jogad*, as the Odia equivalent of the Hindi *jugaad*, were central to understanding these processes of deconstruction, and to conceptualise more 'useful' outcomes from these processes. Chapter 3 introduced this concept, with reference to the wider developmental landscape in the village. It examined a range of development interventions and government schemes which existed alongside the micro-grid, arguing that the practices around appropriation played a key role in how community members and groups appropriated agency (Jauregui, 2014) over development interventions, to remould and repurpose them to fit within their own needs, aspirations and social structures. The application of this, with respect to the micro-grid, established a conceptualisation of the system as something that was being remoulded by the local community, for instance, where the potential offer of alternative solar home lighting systems acted as an opportunity to enact leverage over the micro-grid operators to provide electricity for cheaper, or even free, pricing (see chapter 4). The negotiations around this, and the involvement of state officials also keen to appropriate aspects of the micro-grid, drew the engineers of the system back into a process of re-scripting and readapting their understandings of the micro-grid system.

However, these processes need to be understood with respect the power structures existing in within the community; particularly those around caste and tribe hierarchies and gender structures. As explored in chapter 8, the 'scripting' of the micro-grid took place within gendered paradigms and only with engagement with men in Urjapur. Within the community, both women and Adivasis were excluded from participation in local political processes and Adivasis particularly often had lower access to resources. Therefore, the ability to appropriate agency over the micro-grid was still moulded by circumstance. Where higher men could afford to reject the micro-grid and fall back on using diesel energy for their industrial energy needs, most women in the village lacked access to finance, skills and markets to even begin to consider using the micro-grid for their own purposes. Adivasi families without alternative means of lighting were entirely dependent on the micro-grid system and could not subvert it, even if they felt the costs for it were too high.

The understandings of *jogad*, and how they related to the different meanings and understanding people took from the micro-grid, also extended beyond the Urjpapur community itself. The ways in which other actors, including state officials, drew meaning from the micro-grid was another way in which the dissonances in the system became clear. Chapter 5 particularly explored the relationship between the Urjapur community and the

forest around it. It argued that the forest played a role in the micro-grid, not just in providing context but also engaging with the politics that existed around it. It looked at the way in which the forest office appropriated off-grid energy to support their own aims, but also where they resisted the micro-grid as it threatened attempts to persuade communities to relocate from the forest. Here, the contradictions in how both conservation movements and clean energy technologies coalesce around the concept of 'sustainability' exposed some of the unravelling logic of the micro-grid in the local context.

Chapter 6 expanded this further, looking at the development and implementation of micro-grids across the state by different actors. It explored how micro-grid implementors, including NGOs, state agencies and businesses, used micro-grids to support their own ideologies, politics and values. Built into these models were specific conceptualisations of who users were, or who they should be, which arguably constituted another form of appropriation of micro-grid technologies. However, this chapter also focused on the frequent failure of micro-grid projects, and the ways in which many projects seemed to 'die' from being outcompeted by main grid electricity, through being abandoned by their implementors or from the disillusionment of the communities in which they were installed. This chapter painted a picture of micro-grids as being often unstable, precarious and dependent on the contradictory development logics which undermined their success; a theme which reflected some of the conclusions of chapter 4.

The apparent instability in the Urjapur micro-grid, reflective of many of the challenges faced across the state, provoked questions of how the visions proposed by it were mobilised and how they continued to adhere the micro-grid assemblage. Chapter 7 explored these questions and the role of charisma, in terms of the technologies, people and proposed futures, within the assemblage. It particularly focused on the role of 'smartness' in propelling the vision for the micro-grid. However, it placed these as a counterpoint to more localised versions of charisma, alternative conceptualisations of 'smartness' and the localised disillusionment with off-grid energy technology to argue that the effectiveness or functioning of the system *in situ* was secondary to the vision of it constructed by its implementors. In this, while the micro-grid system in Urjapur appeared precarious, it adhered to a more secure external image.

The final chapter widened the scale of enquiry to explore the interconnections within the social construction of the micro-grid technology. It focused specifically on the gender

dimensions which ran through the micro-grid usage and governance in Urjapur (including their interactions with SolarFuture), through the operations at the university campus and to policy and research circles in Delhi. This widened perspective sought to understand how the patriarchal norms, which were evident at points throughout the fieldwork, were reasserted throughout the micro-grid assemblage. This again resonated with the themes around conflict and contradiction. This highlighted contradictions within the proactive work around gender and energy in Delhi, which was undermined by problematic gendered work environments and the exclusion of young women from producing knowledge on the subject. At all three sites, the drive for transition, change and development which characterised the micro-grid and off-grid energy mandates failed to engage with wider societal changes around gender relations.

The introduction outlined some of the gaps in our understanding of micro-grids in India. It argued that much of the existing literature on micro-grids prioritises technocentric understanding of such systems, leaving little room to explore the social dimensions and politics which exist around them. These technocentric understandings can also fall into the assignment of presubscribed developmental outcomes to the systems, arguably by means of 'problematising' (Escobar, 1995) and 'technologising' (Abdelnour & Saeed, 2014) developmental issues. There are also tendencies to focus analyses of micro-grids on the examination of the factors and variables which enable or disable their function. However, there is an opportunity here to step back from normative ideas of what micro-grids are and to explore the non-linear processes of how micro-grids evolve over time, are reshaped by the communities around them and become negotiated and contended systems, resulting in unanticipated outcomes.

As such, the thesis has attempted to contribute a deep dive into the politics and structures around a single micro-grid case study. Through the use of ethnographic methods, it has sought to step back from prescriptive assessments of what a micro-grid *should* be or what outcomes it *should* achieve, to instead contribute an understand of how such systems are conceptualised by the communities and actors surrounding them. The use of assemblage approaches has enabled engagement with the multitude of intersecting values, ideologies, relationships and meanings drawn from such systems, as well as their material form and technological and operational configurations. This perspective is important, not just in contributing to a deeper understanding of micro-grid technologies themselves, but also in

contributing to a more nuanced understanding of what such systems mean for communities using them. This involves extending how we frame who and what the people using energy from micro-grids are. In part, an important component of this was acknowledging the Urjapur community as much more than as simply 'users' of energy and instead understanding how the micro-grid was situated within the rich, complex fabric of daily lives, relationships and aspirations. Equally important was understanding the role of the Urjapur community as active and engaged participants within the shaping of the micro-grid project, where the concepts of *jogad* become a useful conceptual tool.

9.1 Policy and Practice Recommendations

This thesis has not focused to a great extent on generating recommendations for policy and practice. However, there are some conclusions to be drawn from it which may have relevance to policy makers and practitioners working in the off-grid energy and micro-grid sector in Odisha and further afield.

There is an inherent tension between the technical disciplines wishing to 'do good' with the technology they can develop (Cross, 2019c) and with the monolithic, structural nature of many of the challenges that rural communities face. The absence of grid in Urjapur was, arguably, derived from the political ecologies of its location combined with the deeply entrenched marginalisation of the people living in the community. Thus, any 'solution' provided to fill that void was inevitably caught up in the politics and social structures of the region and of the community itself.

While this thesis has taken a somewhat critical stance of the 'smart' micro-grid concept, I do not necessarily conclude that the technologies proposed by it are fruitless or irrelevant in their aims to provide low-carbon energy solutions for off-grid communities. I do, however, argue that any consideration of them needs to be informed by nuanced and in-depth localised understandings of their context. This echoes other calls for micro-grid projects to pay close attention to the social structures, localised politics and context of implementation (Ulsrud, et al., 2011; Cloke, et al., 2017; Ahlborg, 2017). Situated, qualitative methodologies are central to forming these understandings (Winther & Wilhite, 2015).

A key point of contention throughout my fieldwork was the contrast between how the Urjapur micro-grid was imagined by its designers and the alternative meanings, potential and futures envisaged by its users. From this thesis, I argue that user communities are key actors

in shaping, deconstructing and reassembling the assemblages around micro-grids and that this fits within wider means of appropriating development interventions to suit local needs and priorities. I would propose that the implementors of such systems, wherever possible, should anticipate and embrace the iterative, flexible, dynamic and co-produced nature of off-grid electrification. While the nature of off-grid technologies possibly makes this more challenging, there may be potential for 'smart' technologies in alternative configurations to work to facilitate greater flexibility. However, any 'smartness' within such systems needs to be defined and recognised by user groups, as oppose to purely providing instruments of system control for the designers.

However, as demonstrated in the cases of Urjapur and Karada, there may be an inevitability that for some, off-grid energy in and of itself is inherently reflective of state neglect and becomes entangled with existing disillusionment around solar energy. An awareness of the wider politics and expectations surrounding micro-grids systems (Sharma, 2020) could be central to understanding if they have potential to 'work' in a community, and what the 'working' might mean for different groups and actors within the system (Ahlborg, 2018). Equally, care should be taken to avoid conflating the 'solving' of energy issues with the 'solving' of the structural problems which caused them and to acknowledge that these may be keenly felt by the communities within which micro-grids are being installed.

A key component of micro-grid projects in future could also be tempered expectations, on both the part of the implementors and in communities with micro-grids. Part of this may include an awareness of the charismas of the grander narratives of technological transformation and how they might conflict localised priorities and expectations. Equally, there may be call for a greater humility in the expectations of what solar PV micro-grids and 'smart' technology can achieve in rural villages, which may result in plans for more realistic, modest and incremental change that better engage with priorities of communities members. Where a functioning grid, by and large, falls into the background of daily life (Gupta, 2015), maybe the aims of such systems should be to provide electricity without significant expectation of how people should use it nor a specific vision of the 'transformative' potential of it. The 'smartness' of a technology does not assure any guarantee of a specific type of use or trajectory of development, and nor should it. Indeed, 'smart' or not, inclusive, localised knowledges needs to play a meaningful and ongoing role within technical design processes (Kumar, 2019a). The example of Meragada, in chapter 6, demonstrated that while a long-

term, sustainably functioning micro-grid was very much the exception to the norm, a successful alignment of circumstances enabled a system where the community was able to mould the system to their own needs. This may not be directly replicable elsewhere, but speaks to the potential of what makes such a system 'successful'.

A final point, reflective of the conclusion of chapter 8 of this thesis, emphasises the importance in challenging the patriarchal structures embedded within the micro-grid and off-grid energy sector. This may be through practitioners organisations ensuring they hire (and listen to) people with the skills and positionality to be able to engage over a substantial period of time with more marginalised groups, particularly women (and to their credit, SolarFuture later did this). This may aid in challenging the patriarchal 'scripting' of micro-grid projects (Akrich, 1992; Bray, 2007). Challenging these structures must also mean enabling a greater diversity of researchers and practitioners who are listened to within policy and research spaces, where particularly young women have access to platforms and publishing opportunities. There is arguably also a need for increased levels of accountability through the sector to challenge gendered hierarchies and abuses of power.

9.2 Epilogue

I left Odisha at the end of 2017, not knowing what would happen in Urjapur or to the micro-grid. It was unclear if the tensions between SolarFuture, Urjapur, the micro-grid and the forest authorities would ever balance out and find some kind of equilibrium. I assumed that the negotiations between the community and SolarFuture would continue as they had been, possibly for several years, before the project slowly died, like many of the other micro-grid projects. It was not feasible to plan extensive follow up visits within the time frame available and I had more than enough data from fieldwork to process for the time being. From a distance, I stayed in touch with several contacts in Odisha and continued to periodically check local news sources.

However, I did not anticipate the extent of the upheaval that would take place in the community after I left, with several developments taking place which would significantly alter life in the community and their relationship with the micro-grid. Though they resonate with the wider arguments of this theses, the developments that took place after I left the field have not been analysed within the wider thesis, primarily because of the lack of adequate data. They are included in this conclusion, however, as a way of providing a closure of sorts to the Urjapur micro-grid story, though they also provoke many more fascinating questions.

In early 2019, while preparing for a conference presentation, I was searching online to check a detail about the tiger reserve where I had undertaken my fieldwork. Odisha's English-language news outlets rarely featured much that was happening in the region around my field site, but this time my search was met with a barrage of news headlines about the tiger reserve: "Odisha tigress mauls man to death, second attack in 45 days"; "Odisha: Locals say tigress killed one more, attacks forest officer"; "Tiger translocated from MP [Madhya Pradesh] to Odisha dead"; "With new tiger death, Odisha proves it has learnt nothing"; "Jumbos to patrol Odisha's tiger reserve".

It was difficult to extrapolate exactly had happened. The news articles had some conflicting information, but from what I could surmise, it appeared that in late 2018 the forest office had reintroduced a pair of tigers into the reserve, hoping to reinvigorate the tiger population (and presumably justify its status as a tiger reserve). From the accounts of those in Urjapur, these would be the first tigers living there in upwards of a decade. The potential translocation of tigers from Madhya Pradesh had been a common topic of conversation throughout fieldwork. It had intersected with discussions of the micro-grid (see chapter 5), particularly where communities were being incentivised to relocate outside of the core forest area to give the tigers more space and reduce human-animal conflict.

According to the news articles, not long after their reintroduction, there had been several deadly attacks on local people by the female tiger, including one in a village only a few kilometres from Urjapur. In response, locals had protested, burning down government buildings and boats and blockading roads. The forest office recaptured the tiger and (in possibly the most bizarre turn of events) recruited trained elephants, upon which forest guards would patrol the forest to protect the remaining tiger from poachers and angry communities in the reserve seeking protection and retribution from the new predators. Despite the elephants, the remaining tiger was found dead a few weeks later. The cause of the tiger death was unknown, but the investigation did not seem to implicate either the local communities or poachers.

The news reports were fairly damning of the forest office approach, with conservation campaigners pointing out that the forest corridor that had existed between Odisha's other tiger reserve had been destroyed by extractive industries in the intervening period between when tigers last roamed the reserve and when they were reintroduced. This meant that the tigers would never have had enough space to coexist with villages in the reserve and that

human-animal conflict was inevitable with their reintroduction. The mystery of the tiger's death caused great debate and outrage over the failure of the programme was palpable. However, the majority of the coverage focused on the tigers, while the deaths of the people in the local communities were secondary.

I wondered how the Urjapur community had responded to the tiger attacks. Having lived in the area through the constant the threats of elephant attacks, I could imagine the heightened resentment, fear and upset that would come from man-eating tigers being on the loose. For those working as poorly paid forest guards, there would be a greater threat of poachers, who were often violent, and for women who went into the forest to collect food and firewood the risks would be greater. I wondered specifically how the reintroductions would be viewed with respect to other animals in the forest; were they representative of the selfish aims and impositions of the forest office? Or a return and renewal of the natural habitat of the area?

Regardless of how the tigers themselves had been received, these events reaffirmed much of what I had heard across the community; that the forest office was self-serving and valued the animals more than they did the community, that the risks the community faced from the forest were increasing, and that, in years gone by, they would have been better equipped to protect themselves. It was striking that the trained elephants had been deployed to protect the remaining tiger, while the news article mentioned nothing about how the communities navigated the risk or were helped by the forest office. I could imagine that Ravi and his family might have participated in the protests, as they had in previous protests, but I wondered how others in the community would react. I assumed that the forest office would have to go much further than providing solar lanterns and a solar powered fence to placate people this time and wondered how this would impact on how people felt about the forest office and relocation plans.

I did not investigate the topic much further, assuming I could come back to it once I had finished writing up my fieldwork material. However, a few months later, any assumptions I had made about the fallout from the tigers was once again uprooted, when I received an update on the Urjapur micro-grid.

Anshuman contacted me saying that he was working with a researcher at a US university to model the social impacts of his micro-grid programmes. He asked me to video conference with her to give her the context of what kind of things she should include in a set of matrices she was planning to quantify the developmental impacts of a 'smart' micro-grid project. I was

hesitant to get involved, aware of the potential hazards in using solely normative matrices to evaluate the micro-grid. However, if they were going to undertake a social impact evaluation anyway, I could at least steer her in a direction that might acknowledge some of the issues in their approaches (for instance, in ensuring any study would include evaluating the involvement of women in decision making).

During the conversation with her and another SolarFuture engineer, it became clear that the Urjapur micro-grid was no longer their main focus. Instead, they were working in another village in the area. They were also working on projects in different states, but Urjapur, formerly their showcase 'proof of concept' project, was not mentioned. I asked about it, and was told that main grid access had been extended to Urjapur in the lead up to the 2019 Odisha state and Indian general elections. Apparently, the local member of the legislative assembly (MLA), keen to secure votes in the area, had bulldozed any forest office mandates and electrified the village anyway. Undoubtable, this move would secure the votes of the entire village for many years to come.

The entire premise of the micro-grid in Urjapur had been that the grid, and other infrastructure, could not be extended there because forest acts prohibited the extension of grid lines into the core forest area. I had been told this more times than I could count. Yet, in the throes of electoral campaigning , it had apparently become irrelevant. It was unclear from the SolarFuture engineer whether they were still providing the 'smart' backup to the Urjapur micro-grid, but it was clear that their focus had moved to other projects.

It came as a shock to hear that things had so drastically changed. The development spoke to both the precarity of SolarFuture's operations in the village, where the paradigms around energy access, upon which their operating model hinged, could be flipped upside down so quickly, but also to the façade of forest office control. Where, just months previously they had effectively let man-eating tigers loose on the forest communities, apparently without any oversight or accountability, their proverbial 'line in the sand' on infrastructure provision had been blown away by one person's electoral ambitions.

SolarFuture had staked huge amounts of money, time and effort on the assumption that grid would not be extended into the core forest area; an assumption that went unchallenged by all except the Urjapur community themselves. During fieldwork, Subhra and I had wondered why Ravi's family continued to petition the block office for grid, when it seemed apparent that grid *could not* be extended to village. For us, it seemed to be an immutable fact of the

community's geography, and yet, the community had actively deconstructed and challenged this paradigm. They saw through the rigid mandates of the forest office in a way that SolarFuture, and Subhra and I, had not.

Without a follow up visit, I have limited information on what exactly had happened and how the grid had been extended. The SolarFuture engineer was not particularly forthcoming and I was aware that they also may only have part of the story. I found it hard to believe the grid extension had materialised out of nowhere; maybe Ravi's efforts to petition the block office for the grid had finally paid off and the community had, indeed, managed to leverage the developmental outcomes they wanted. Or maybe the provision of grid had been allowed by the forest office in their attempts to placate the communities after the tiger debacle.

I wondered how the grid would have changed the village and, in particular, if it had changed how the community viewed themselves. The arrival of grid in the wake of the micro-grid presented a whole new set of questions to be explored. Presumably, the village was no longer 'smart', or, at least, if the micro-grid did still function, the 'smartness' would no longer have the same hold over how electricity was consumed. But would the provision of state grid actualise state inclusion as some wanted, or was grid only a piece in the much larger puzzle of the provisions that were missing in the community? Would their newfound grid connectivity signal another, newer or more localised type of 'development' or even 'smartness'? Or would this continue to be undermined by the actions of the forest office and other institutional barriers? While grid electricity possibly came with fewer of the expectations of 'transformation' than the micro-grid, would it live up to what the community wanted? Could it be moulded to support the aspirations of people across the community or would it be co-opted to support the interests of a select few? On a pragmatic level, would the grid even supply 24-hour power or would there be long periods of blackout? Would the community ever miss their regularised micro-grid scheduling? Would the equipment providing the grid breakdown and when it did would it be fixed? Would the presence of grid catalyse an entirely new set of *jogad* processes, as people across the community appropriated it and the structures around it?

The apparent ease with which the grid could be extended to the village, at least when it became the priority of someone in the position to do so, rendered the Urjapur micro-grid assemblage even more fragile and transient (Huang, 2020) than I had envisaged. It also re-illuminated many of the contradictions in the micro-grid model that had arisen throughout

fieldwork. The single, rigid version of 'smart' that it proposed was far from adaptable or derivative of local understandings of 'smartness', development or progress. It had been constantly deconstructed, by those in the community who resented its symbolism of state neglect, or by those who wished to remould it for their own patterns of use. It was deconstructed by forest officers who saw it as a pawn within their own forest management and tiger relocation projects. Ultimately, it was also deconstructed by the MLA, who, consciously or not, had more to gain from surpassing the micro-grid with a grid connection for the village. There was a distinct irony that the 'transformation' that was proposed by the micro-grid effectively hinged on the withholding of alternative types of transformation or progress, regardless of the aims of the community.

And yet, despite the apparent end of the Urjapur micro-grid project, the wheels of the SolarFuture operation kept on turning. They moved onto other villages, which would presumably pose other challenges and have a whole set of their own varied responses. SolarFuture had learnt from their Urjapur engagements; this was evident even during my fieldwork, where Anshuman and Santosh had occasionally reflected on their decision to work with OREDA, their need to more proactively work to develop energy based livelihoods with the community and where the tensions around payment had stemmed from. Their learning was also evidenced in how women and marginalised groups engaged with the projects, with SolarFuture later hiring at least one woman to work for them. Indeed, the efforts from the community to remould the Urjapur micro-grid may arguably have had a lasting impact on the design and operation of future projects. Not only had the Urjapur community participated in the remoulding of their micro-grid, through their processes of *jogad,* but also played a key role in 'scripting' (Akrich, 1992) future iterations of 'smart' micro-grid projects, whether or not this was acknowledged or appreciated.

The developments after my fieldwork has made me even more keenly aware of the value in doing qualitative, grounded and longitudinal fieldwork around micro-grids and other similar renewable energy interventions. The project was far from being a linear process of design, implementation, usage and end of life, causing discrete and definable impacts. It was dynamic and evolved constantly, being shaped and reshaped by those surrounding it. Even after spending the best part of a year in Urjapur, there were still things that happened that surprised me and challenged the assumptions I had made around it. Even in the final months of my own fieldwork, I still heard new and different opinions and perspectives on the system.

I would presume that any of the other micro-grids sites that I made short visits to would have had equally complex stories, and equally contended notions of what people wanted and how people envisaged their futures. This constant evolution needs to be researched on its own terms.

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